

Capacity Building and Mentorship for the Establishment and Implementation of Monitoring & Evaluation Programmes on Experimental and Long-Term Pavement Performance (LTPP) Sections in Six Africa Countries and Myanmar

Report on Initial Visit to Myanmar (Final)



Civil Design Solutions

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Cover photo: Visual Condition Assessment

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Abstract

The Research for Community Access Partnership (ReCAP) is providing support to Road Research Centres (RRC) in sub-Saharan Africa and Asia to collect performance-based data from existing trial/demonstration road sections. The data will provide evidence for the development of appropriate specifications for Low Volume Roads. Monitoring is being carried out in accordance with existing ReCAP draft regional guidelines for the monitoring of experimental road sections, which will be updated under the project.

The CDS advisory team visited Myanmar from 7th – 13th July 2018. The team met staff of the Ministry of Works (MOW) and the Department for Rural Road Development (DRRD) and assisted them to establish four monitoring sections on the TGI 1 Road near Tuanggyi in Shan State. The road was upgraded to a paved standard in 2016 including the construction of four “experimental” sections using different surfacing types and two control sections of Penetration Macadam. The newly formed Research and Development Unit (RDU) of the DRRD is tasked with monitoring the performance of the experimental sections.

The project road is carrying a relatively high volume of traffic including large trucks transporting a variety of commodities including agricultural produce, quarried stone and fuel. The experimental sections were designed using Overseas Road Note 31 for up to 1.5 million equivalent standard axles. The monitoring of these sections will therefore not provide evidence for developing new specifications for low volume roads in Myanmar, but they provide a useful training site for RDU staff on the establishment of monitoring sections and conducting most of the standard measurements and tests. Some baseline data were collected during the visit and the requirements for future monitoring and data collection were discussed. The institutional arrangements for DRRD involvement in the subsequent monitoring of the sections was discussed as well as the need to acquire certain items of research equipment.

Key words

Performance Monitoring, Low Volume Roads, Capacity Building

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The authors would like to acknowledge the significant contribution of the Myanmar MOC and the DRRD in the organisation of the visit and the field work and their kind hospitality. The support of the ReCAP Regional Technical Manager for AsCAP and the ReCAP Technical Manager for Myanmar, who accompanied the CDS team.

Research 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.

www.research4cap.org

Acronyms, Initialisms, Units and Currencies

AASHTO	American Association of State Highway Officials
ADB	Asian Development Bank
AfCAP	Africa Community Access Partnership
AsCAP	Asia Community Access Partnership
BI	Bump Integrator
BS	British Standard
CDS	Civil Design Solutions
CMA	Cold Mix Asphalt
DBST	Double Surface Treatment
DCP	Dynamic Cone Penetrometer
DF	Drainage Factor
DFID	Department for International Development
DN	Depth of Penetration of the DCP (mm/blow)
DR Congo	Democratic Republic of Congo
DRRD	Department for Rural Roads Development (Myanmar)
ERA	Ethiopia Roads Authority
FWD	Falling Weight Deflectometer
GPS	Global Positioning System
KfW	Kreditanstalt für Wiederaufbau
LWFWD	Light Weight Falling Weight Deflectometer
LTPP	Long-Term Pavement Performance
LVR	Low Volume Road
LVSR	Low Volume Sealed Road
MOC	Ministry of Construction
MTRD	Materials Testing and Research Department
ORN	Overseas Road Note
Pen. Mac.	Penetration Macadam
RDP	Rural Development Programme
RDU	Research and Development Unit
ReCAP	Research for Community Access Partnership
RRC	Road Research Centre
SANS	South Africa National Standards
TMH	Technical Methods for Highways
TRRL	Transport and Road Research Laboratory (now TRL)
TRL	Transport Research Laboratory
UK	United Kingdom (of Great Britain and Northern Ireland)
UKAid	United Kingdom Aid (Department for International Development, UK)

1 Introduction

1.1 Purpose of the Report

This report covers the Initial Visit of the CDS advisory team to Myanmar for the project for Capacity Building and Mentorship for the Establishment and Implementation of Monitoring and Evaluation Programmes on Experimental and Long-Term Pavement Performance (LTPP) Sections in Six African Countries and Myanmar. The report summarises the activities carried out on the visit, the challenges presented by the project, and recommendations for the way forward.

1.2 Background

The Research for Community Access Partnership (ReCAP) is a six-year programme of applied research and knowledge dissemination funded by a grant from the UK Government through the Department for International Development (DFID). The overall aim of ReCAP is to promote safe and sustainable rural access in Africa and Asia through research and knowledge sharing between participating countries and the wider community.

Cardno Emerging Markets (UK) Ltd has been contracted by DFID to manage ReCAP. There are two components under ReCAP: the Africa Community Access Partnership (AfCAP) and the Asia Community Access Partnership (AsCAP). ReCAP provides technical assistance for a significant portfolio of research activities and promotes the uptake of the research findings through revised, country specific design standards and specifications.

ReCAP is providing support to Road Research Centres in six countries in Africa and one country in Asia – Myanmar - to collect performance-based data from existing trial/demonstration road sections. This data is expected to provide evidence for the establishment of appropriate, cost-effective standards and specifications for Low Volume Roads. The road sections are being monitored and evaluated in terms of their performance related to pavement design, materials and surfacing, drainage design, geometric design and road safety, in accordance with existing guidelines for the establishment and monitoring of experimental and LTPP road sections.

The countries that are participating in the project are Malawi, Kenya, Uganda, Ethiopia, South Sudan, DR Congo and Myanmar. In the African countries the collection of data on the research sites is being carried out by local consultants and the analysis by the research centres. In Myanmar the field work and data analysis are being carried out by the Research & Development Unit (RDU) of the Department for Rural Road Development (DRRD) in the Ministry of Works.

Civil Design Solutions was contracted by Cardno to provide capacity building and mentorship support to the research centres of the participating roads agencies and additionally, in Africa, to the national consultants that have been engaged to collect data on the trial/demonstration road sections on behalf of the respective roads agencies in all of the participating countries. Support will also be provided for the analysis of the data and reporting of the results.

1.3 Research objectives

The research objectives of the project include:

- Support the six participating Road Research Centres (RRC) in Africa and DRRD RDU in Myanmar with managing the establishment and implementation of monitoring programmes on selected road sections;
- Provide in-service training and mentorship to RRC personnel and local consulting firms conducting the monitoring of the trial sections;
- Support the RRCs with the analysis and reporting of data obtained from the sites;
- Further develop and customise existing regional (Africa) guidelines for the establishment and monitoring of experimental and LTPP Sections to ensure harmonised implementation in the region and consistency of methodologies for collecting performance data to facilitate compatibility and comparability of data for analysis; and
- Recommend modifications to the existing design standards and specifications for Low Volume Roads (LVRs) based on the performance data collected, collated and analysed from the on-going LTPP monitoring programmes.

1.4 Methodology

In accordance with the Terms of Reference, the task to be carried out by the CDS Advisory Team in Myanmar is to provide capacity building and mentorship support to the RDU for:

- managing the establishment and implementation of a monitoring programme for the surfacing trials sections; and
- supporting the DRRD with the analysis and reporting of the data.

The CDS team is expected to visit Myanmar five times over the two-year duration of the project. A report will be submitted after each visit summarising the progress made with the monitoring of the research sections, a review of any data and interim reports submitted by the RDU since the previous report, and a programme of monitoring activities for DRRD for the next reporting period. The fifth visit will include a project workshop to discuss the overall project findings.

1.5 Mobilisation of the Team

The project advisory team for the initial visit to Myanmar comprised:

- Robert Geddes – Project Director;
- Mike Pinard – Materials Expert; and
- Pham Gia Tuan - Trials Monitoring Engineer.

Preparations for the visit were made in consultation with ReCAP PMU staff and the DRRD. The proposed itinerary for the visit and a list of required equipment for use on the sites was prepared and sent to the DRRD. The CDS team was accompanied by the AsCAP Regional Technical Manager and the AsCAP Technical Manager for Myanmar.

The activities carried out during the Myanmar visit and the principal findings are summarised in Chapters 2 and 3.

2 Activities Carried Out

2.1 Visit Programme

The visit was undertaken from the 7th to the 13th July 2018. The itinerary for the visit is given in Table 1.

Table 1: Itinerary for Myanmar Visit

Day	Date	Task
Saturday/Sunday	7/8 July	Travel of CDS team and AsCAP Regional Technical Manager to Yangon
Monday	9 July	Travel of CDS team and AsCAP Regional Technical Manager to the project site in Shan State. Kick-Off Meeting at the site office with MOC staff and the consultants responsible for supervision of the works on the road.
Tuesday	10 July	Overall inspection of the research sections, marking of section 1 and section 2 and data collection.
Wednesday	11 July	Marking of section 3 and section 4 and data collection. Wrap-up meeting
Thursday	12 July	Travel to Yangon
Friday	13 July	Departure of team from Myanmar

2.2 Tasks Carried Out

2.2.1 Kick-off Meeting

The Kick-off Meeting was held at the site office on the TGI 1A road near Taunggyi in Shan State in the afternoon of Monday 9th July. The meeting was attended by the AsCAP Regional Technical Manager, the AsCAP Technical Manager for Myanmar, staff and officials of the DRRD/Ministry of Construction, and representatives of Gauff Ingenieure who are supervising the road works under the Rural Development Programme (RDP). The meeting was chaired by Soe Tun Naing, a Director in the DRRD. The Director of the newly formed Research and Development Unit (RDU) was unable to attend the meeting or the subsequent site activities. A list of participants in the meeting is included in Annex 1. All of the DRRD/MOC staff at the meeting participated in the field work.

The following issues were discussed at the meeting:

- Overall project approach and objectives, as set out in the CDS Terms of Reference.
- Background to the RDP - This programme is now in its third phase and involves upgrading gravel and earth roads to paved standard. The project is funded by KfW, a German government owned development bank.
- Background to the project road - The research project road was upgraded in 2016 under the first phase of the RDP. The surfacing is Penetration Macadam, except on the trial sections which include double surface dressing, unreinforced concrete slabs and concrete block paving.
- Roles and responsibilities for the management of the research project on the trial sections - DRRD will be responsible for the monitoring of the sections through the RDU. A Focal Person will be appointed as the point of contact for the CDS team.

- The purpose of the research project - Generally, the rural roads in Myanmar are in a poor state. Penetration Macadam, which is the most commonly used surfacing material, can have a life of only three to four years due to poor construction quality and lack of maintenance. More durable and cost-effective options are needed.
- World Bank and Asia Development Bank rural road project - It is intended by DRRD/MOC to incorporate further trials in this forthcoming rural roads programme that is currently being developed by the World Bank and the ADB. The possibility of considering other potentially suitable, cost-effective options, such as Cold Mix Asphalt and Cape Seal, was discussed.
- Presentation of draft regional Monitoring Guidelines for LTPP and Experimental Sites - These were summarised through a PowerPoint presentation, including the guidelines for the layout of the sections to be monitored and rating of the degree and extent of defects on bitumen sealed roads under the visual condition survey and accompanying photographs to facilitate this task.
- Arrangements for the field work on the following two days - Most of the required equipment was available for the field work, including a mobile laboratory.
- Procurement of additional equipment - DRRD will need to procure equipment for the monitoring work including:
 - A MERLIN for roughness measurements (currently, the DRRD only has mobile laboratory profilometer equipment to measure road surface roughness);
 - A Nuclear Density Gauge to enable more rapid density measurements (the DRRD currently only has sand replacement test apparatus); and
 - A mobile weighbridge.
- Deflection measurements - These can be undertaken using the existing Benkelman Beam, although the acquisition of a Light Weight Falling Weight Deflectometer (LWFWD) may be a future option.
- Availability of as-constructed information on the trial sections - A report was obtained on the monitoring already carried out on the trial sections and prepared by Gauff Ingenieure¹. The key features of this report are summarised below.

¹ German Financial Cooperation with The Republic of the Union of Myanmar. Rural Development Programme - Phase I. Control of pilot pavement trial sections TGI-1A - Evaluation and recommendations. Gauff Ingenieure.

Figure 1: Kick-Off Meeting



2.2.2 Relevant Literature

The following documents have been obtained that provide important background information to the monitoring of the trials on the TGI 1A road, the identification and design of future trial sections, and the strategy for developing research capacity for LVRs in Myanmar.

- Dingen, R and Cook, J. (2018). Review of Low Volume Rural Road Standards and Specifications in Myanmar. ReCAP Project Activity Number MYA2118B.

This report includes a gap analyses of low volume rural road standards and specifications based on a review of existing Myanmar standards and specifications used elsewhere in the region and in other parts of the World. The report identifies possible refinements of the existing standards and specifications relevant to the wide range of rural road environments within Myanmar. A flexible approach to the development of standards is proposed, with new pavement, surfacing and geometric standards developed within the current rural road classification system used by DRRD. The report recommends the preparation of a new Low Volume Rural Roads Manual for Myanmar.

- Dingen, R and Sann, T. (2018). Review Workshop Low Volume Rural Road Standards and Specifications in Myanmar. Workshop Report Nay Pyi Taw 12 January 2018. ReCAP Project Activity Number MYA2118B.

The purpose of this report was to record the proceedings of a Review Workshop held in Nay Pyi Taw, Myanmar, on 24th January 2018. The workshop discussed the findings of the review of existing standards and specifications including the need for diversification and further refinement of standards and specifications. The way forward towards the development of a Design Manual was agreed.

- Gauff Ingenieure (2018). Rural Development Programme - Phase I. Control of pilot pavement trial sections TGI-1A - Evaluation and recommendations. German Financial Cooperation with The Republic of the Union of Myanmar.

This undated report states that the monitoring was carried out two years after the construction of the trials. It is therefore assumed to have been written in 2018. The report includes detailed

specifications for each of the trial sections as well as the materials used and the construction method adopted. Investigations that were carried out for the monitoring included:

- Visual Survey to identify typical defects on each trial section (through defects were not recorded by degree and extent);
- Roughness Survey (using the mobile App RoadLabPro);
- Core Boring, with three cores taken from each trial section;
- Sieve Analysis of base and sub-base samples obtained from the cores from the granular pavements;
- Dynamic Cone Penetrometer (DCP) tests taken in the subgrade using the holes formed by the core boring, and conversion of the DN values to CBR;
- Rebound Hammer Test carried out on the concrete slabs and the concrete blocks;
- Benkelman Beam test for deflections carried out on the flexible pavement sections.

The data obtained from all of these tests is included in the report, which also includes costs data for each of the trial sections. Recommendations are given for repairing defects observed on the road, clearing the drainage system and strengthening the pavement on some of the sections. The report recommends six-monthly inspections and regular maintenance.

The Gauff investigation was not done in accordance with the ReCAP monitoring guidelines that will be established as the standard for Myanmar under the current project. The Gauff data provides useful information on the construction of the trial sections and their condition after two years, but it does not provide a relevant baseline for long term monitoring under the ReCAP project.

- van Dissel, S.C. (2016). Myanmar Programme Planning with DRD. ReCAP Project Activity Number MYA2080A. Cartier Consult.

This report summarises the findings of an assignment to identify likely areas of research, capacity development and knowledge transfer in Myanmar which could be supported by ReCAP. These are presented as an outline country programme and concept budget. A secondary purpose of the assignment was to confirm areas within rural transport programmes of the World Bank, ADB and KfW that would benefit from cooperation and added value from ReCAP/AsCAP. One of the priority areas for ReCAP support that was identified was “the preparation of detailed rural road and bridge standards”.

- Verhaeghe, B. (2018). Establishment of Rural Road Research Capacity in Myanmar/RDU Business Plan for First Five Years of Operation. Final Version. ReCAP Project Activity Number RAS2117A. CSIR.

This report presents a Business Plan for the first five years of operation of the new Research and Development Unit (RDU) of the Department of Rural Road Development (DRRD) in Myanmar. The Business Plan addresses the vision, mission, goal and strategic objectives of the RDU, governance and oversight, the institutional and physical location of the RDU, sources of funding, key performance indicators, strategic linkages, a short to medium-term research agenda, capacity development (human resources and research infrastructure) and knowledge management. The Business Plan is expected to evolve over time in line with the changing views and expectations of the DRRD and the realities associated with the establishment of the RDU

2.2.3 Trial Sections

The details of the five trial sections on TGI 1A are summarised in Table 2. Typical photographs are included in Figure 1. “Trial A”, which includes conventional Penetration Macadam surfacing was used for the first and last sections.

Table 2: Trial Section Details

No.	Section Length			Road Width			Road Pavement		Road Surface
	Start	End	Length of section	Shoulder	Carriageway	Road Width	Macadam Sub Base	Macadam Base	
			m						
Trial A	0+000	0+500	500	1.00	4.50	6.50	200	150	Penetration Macadam Single chip seal over penetration layer
Trial B	0+500	0+900	400	1.00	4.50	6.50	200	150	DBST ² over Prime Coat
Trial C	0+900	1+150	250	1.00	4.50	6.50	150	-	200mm thick 30MPa non-reinforced concrete
Trial D	1+150	1+350	200	1.00	4.50	6.50	200	-	70mm thick 25MPa concrete block on sand bedding layer
Trial E	1+350	1+750	400	1.00	4.50	6.50	200	150	Emulsion DBST over DBM ³
Trial A	1+750	2+109	359	1.00	4.50	6.50	200	150	Penetration Macadam Single chip seal over penetration layer.

Source: Gauff Ingenieure (2018)

Figure 2: Typical Photos of the Trial Sections



Penetration Macadam



Double Surface Treatment

² Double Surface Treatment (Double Chip Seal).

³ Dry Bound Macadam.



Unreinforced Concrete Slabs



Concrete Blocks

2.2.4 Traffic on the Road

The traffic using the road includes a wide range of vehicles from motorcycles to heavily laden 6-axle trucks. The volume of traffic is high for a rural road. The trucks were seen to be carrying rock from the numerous quarries along the road and agricultural produce. Typical vehicles using the road are shown in Figure 3.

The traffic survey carried out for the design of the trial sections in 2011 gave a daily traffic of 200 4-wheel vehicles per day. Using the relevant axle load equivalency factors this gave a traffic loading of about 23 equivalent standard axles (esas) per day or 270,000 esas over the 15-year design life, with an annual traffic growth rate of 10%. This figure was doubled for channelling on the narrow road section, giving a design traffic loading of 540,000 esas. In order to allow for overloading, traffic class T3 was selected for design of the pavement using Overseas Road Note (ORN) 31. The T3 traffic class is in the range of 0.7 to 1.5 million esas⁴.

It is evident from site observations that the traffic loading will exceed the 540,000 esas estimated at the design stage and that the road does not comply with the normal definition of a low volume road⁵. This will be verified through traffic counts and an axle load survey to be carried out by the RDU.

Figure 3: Vehicles Using the Road



⁴ Source: Dr J. Cook.

⁵ Low Volume Roads are normally defined as those carrying less than 300 vehicles per day and less than 1 million standard axles over their design life.



2.2.5 General Impressions of the Trial Sections

The trial sections are performing reasonably well after 2 years in service. The principal shortcomings are as follows:

- The paved road width (4.5m) is too narrow to accommodate the traffic using the road - edge defects (edge break and edge drop) are occurring due to heavy vehicles moving on and off the road;
- Cracks have formed in the concrete slabs, particularly at the corners of the panels;
- Some of the concrete blocks have cracked;
- The DBST section shows significant bleeding (but this is not likely to lead to pavement failure as i) the surface is likely to remain intact despite high temperatures, ii) skid resistance is not of concern due to the slow speed of vehicles using the road, and iii) further bleeding is unlikely to occur as the binder will be hardening with time); and
- The side drains are sufficiently deep and the three culverts on the trial sections appear adequate for the flow of water during the rains, but there is no maintenance being carried out to keep the drains clear of vegetation.

Figure 4: Typical Defects



Edge break



Crack in concrete slab

Edge drop



Bleeding

The “single-sized” aggregate used for the DBST trial section was obtained from the quarry adjacent to the site (see Figure 10). The aggregate was observed to be non-cubical in shape and with a high flakiness value. It does not comply with normal specifications for aggregate used in surface dressing. This is a possible cause of the bleeding observed on the road. The seal is probably acting more as a graded aggregate seal than as a DBST.

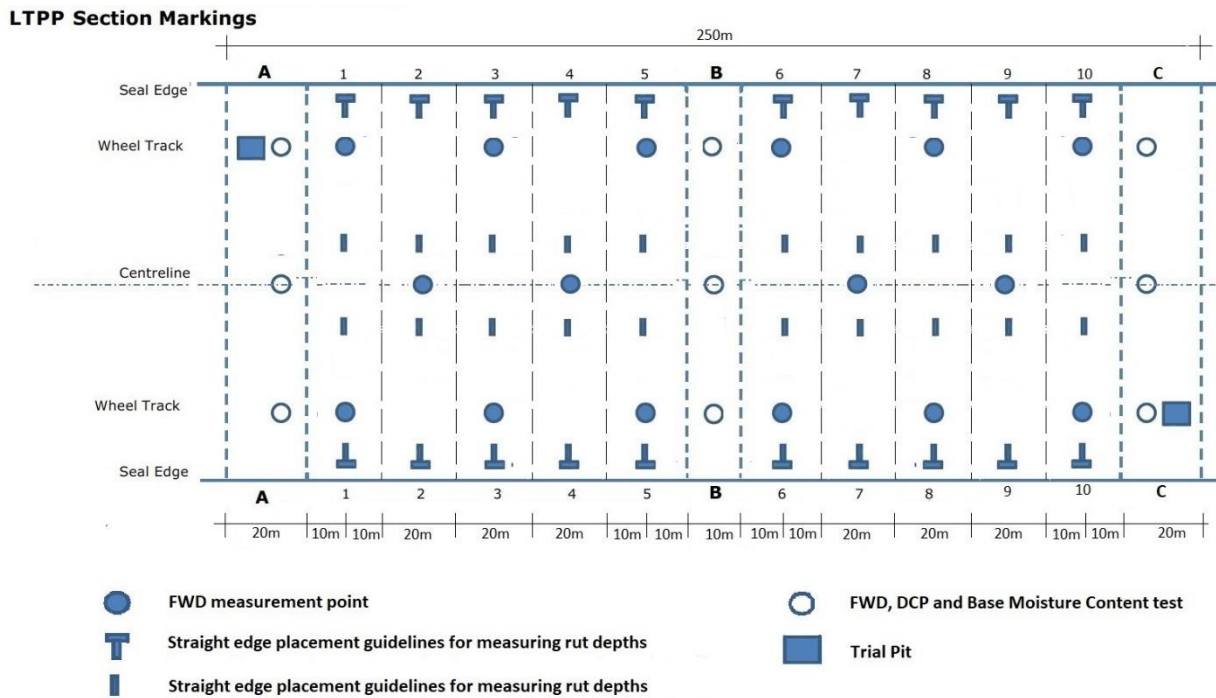
Figure 5: Flaky Aggregate used in DBST



2.2.6 Marking of Monitoring Sections

Monitoring sections were marked out on the road on Trials A, B, C and D. The marking system complies with the regional monitoring guidelines, with some modifications to take account of the narrowness of the road. The marking system is shown in Figure 3. Spray paint was used to make the various markings.

Figure 6: Marking System



On Trial D (concrete blocks) panels 5 and 10 were omitted and panels A and C reduced to 10m long to fit within the 200m length of the section.

Steel pegs encased in concrete were placed at the beginning and end of each trial section and a GPS coordinate was recorded at the start of the project road.

2.2.7 Measurements Taken

The measurements that were taken on the road during the two days of field work are summarised in Table 3. It is expected that the RDU will continue to take further measurements in their own time and before the next visit of the CDS team. These requirements were discussed at the wrap-up meeting (see Section 2.2.8).

Table 3: Measurements Taken

Section	Surfacing	Measurements taken
Trial A	Pen. Mac	<ul style="list-style-type: none"> GPS coordinates at the start of the section. Visual condition assessment of two panels. Rut depth in panels 1 to 10 both sides of the road.
Trial B	DBST	<ul style="list-style-type: none"> Visual condition assessment of one panel. Rut depth in panels 1 to 10 both sides of the road. Drainage factor in panels 1 to 10 both sides of the road.
Trial C	Unreinforced concrete	Nil
Trial D	Concrete blocks	Nil
Trial E	Emulsion DBST	Nil
Trial A	Pen. Mac	Nil

Figure 7: Visual Assessment – Assessing Binder Quality



Figure 8: Measuring the Drainage Factor



2.2.8 Wrap-up Meeting

The Wrap-up Meeting was held at the site office on TGI 1A in the late afternoon of 12th July. The full team that had participated in the field work was present.

The issues raised at the Wrap-Up meeting included:

- The research team should continue with the field work including the following:
 - Rutting measurements on Sections 3 and 4.

- Drainage factor measurements on Sections 1, 3 and 4.
 - Complete visual condition assessments on Section 1 and 2.
 - Conduct at least one traffic count on the road (7-day, 16-hour count with 24-hour count on one of the days).
 - Conduct a 3-day 12-hour axle load survey on the road.
 - Measure the deflection at each FWD point on the marked sections
 - Measure the roughness of each section using a MERLIN.
- CDS will provide specifications for the MERLIN equipment⁶ and a traffic count form (see Annex 2).
 - DRRD need to purchase a calibrated wedge to be used in rut depth measurements.
 - All of the road markings need to be repainted with more durable road paint (white or yellow) before they fade.
 - The DRRD needs to nominate a Focal Person for the project who will coordinate all project activities and act as the point of contact for CDS.

Figure 9: The Research Team at the Wrap-Up Meeting



⁶ TRRL Research Report 301 “The MERLIN Low-Cost Road Roughness Measuring Machine” has been shared with DRRD by email with a recommendation to search for suppliers on the Internet. ORN 40 “A Guide to Axle Load Surveys and Traffic Counts for Determining Traffic Loading on Pavements” was also shared with DRRD.

3 Observations and Recommendations

3.1 Pavement Design and Surfacing

The TGI-1A road is probably not a low volume road. It was designed to conventional standards using ORN 31. The base and sub-base comprise crushed rock as Dry Bound Macadam (DBM), which is a conventional pavement design used in Myanmar. The rock is obtained from small privately-owned quarries along the road using single stage crushers and the construction process is highly labour intensive. The use of DBM and Penetration Macadam leads to relatively high roughness levels. A better product would be achieved by additional processing of the rock to produce a crusher run which would be laid and levelled prior to processing and compaction by machine (grader). It could be combined with a double surface dressing. However, this would reduce the employment opportunities on road works, many of which are taken up by women. Alternative surfacing options that could be potentially cost-effective in Myanmar include Cold Mix Asphalt (very conducive to the use of labour) and the Cape Seal (essentially a Single/Double Surface Dressing with a single/double layer of slurry).

Figure 10: Crusher and Hillside Quarry



Single stage crusher adjacent to the site



Typical hillside quarry close to the site

The research site that has been selected on the TGI 1A road will not provide evidence for appropriate standards for materials and pavement design for low volume roads. It is understood that there is a new rural roads project under preparation that will also incorporate trial sections. This project will be funded by the World Bank and the ADB. It is recommended that ReCAP management should engage urgently with the DRRD and the project funding agencies to ensure that maximum benefit is derived from the trials. For example, it was evident from limited travel in Shan State during the visit that there are sources of natural gravel that might be suitable in upper pavement layers for LVRs. Trials are required to investigate the viability of using these materials, including the implications of a more equipment-based construction process and the maintenance requirements.

3.2 Capacity Building for the RDU

The CDS team was not able to meet the Director of the RDU during the visit. This would have enabled the team to obtain more information on the plans for establishing the RDU. Director Soe Tun Naing from the RDU participated in the training and field work.

The biggest challenge to capacity building for the Myanmar staff of the RDU or DRRD is communication. The level of English spoken was found to be relatively low. However, it was found that once a concept had been carefully explained to the trainees it was well understood and carried out diligently on site. The trainees worked well as a team.

It is evident that the support to the RDU being provided by CDS will need to focus on training of the researchers rather than simply accompanying them during the data collection activities. The staff that are receiving the training have minimal experience in this type of work. The need for greater focus on training will require a change to the currently envisaged inputs of the CDS experts, with a greater share of the input required from the Project Director and the Materials Expert to undertake such training. The CDS Trials Monitoring Engineer may have a role later in the project after the completion of the basic training, but is not well equipped to respond to the current priority for basic training.

Improvements are needed to the existing monitoring guidelines to make them more user-friendly. In particular, the guideline requires more photographs to clearly describe the degree and extent of defects on the road to be recorded in the visual condition survey. Consideration will be given to preparing a separate “Rater’s Manual” before the next CDS visit to Myanmar.

The reporting formats to be used by the RDU will have to be designed to accommodate the low capacity for English. Initially the reports should focus on simply presenting the raw data collected on site in tables. The same approach can be applied to simple analysis of the data to demonstrate any trends that may occur over time.

Given that the TGI 1A road is probably not a LVR and is constructed to conventional design standards, it is apparent that the greatest value in the training and capacity building work that is being done on site through the project is to enable the RDU to familiarise themselves with the use of the equipment for collecting data, recording measurements on appropriate forms, and carrying out basic analysis in order that they can establish and monitor trial sections on other sites in future. This will maximise the Capacity Building and embedment potential of the project.

3.3 Coordination Between Related Projects

ReCAP is currently advertising for consultants to carry out capacity building for the RDU (ReCAP project MYA2153A). The purpose of the project is to assist the RDU to implement the business plan developed with CSIR (Verhaeghe, 2018) and “develop the professional and managerial expertise of the (newly appointed) RDU staff so that they are better able to perform their official duties in an efficient and safe manner”. Coordination will be required between the Capacity Building project and the LTPP monitoring project as they have similar objectives.

The LTPP project should also have close links with the upcoming ReCAP project MYA2118A, “Development of Guidelines and Specification for Low Volume Roads in Myanmar”, which will aim for “the formal adoption into practice of a new LVRR design guideline appropriate to the varied requirements and physical environments within Myanmar”. This project will build on the findings of the AsCAP project “Review of Low Volume Rural Road Standards and Specifications in Myanmar” (ReCAP Project MYA2118B, 2018). However, the trial sections on road TGI 1A in Shan State will provide minimal evidence for “new practice” in low volume road design as the road carries high traffic and is built to conventional design standards.

3.4 Next Steps

It is proposed that the CDS Project Director and Materials Expert should visit Myanmar within six months to continue the training process for the research team. This will include:

- training in the rating of degree and extent of defects on the concrete slabs and concrete blocks;
- training in the use of the MERLIN and the undertaking on Benkleman Beam deflection measurements;
- investigation of the usefulness of marking a monitoring section on Trial E (emulsion DBST);
- excavation of one test pit, probably in the DBST section;
- demonstration of the use of the DCP in the subgrade below the test pit hole; and
- agreement of reporting formats for the data collected on site.

Meanwhile the RDU/DRRD should:

- confirm the point of contact for communications with CDS;
- repaint the markings on the monitoring sections with road paint (white or yellow);
- continue with the monitoring activities identified during the Wrap-up Meeting as follows:
 - Rutting measurements on Sections 3 and 4;
 - Drainage factor measurements on Sections 1, 3 and 4;
 - Complete visual condition assessments on Section 1 and 2;
 - Conduct at least one traffic count on the road (7-day, 16-hour count with 24-hour count on one of the days);
 - Conduct a 3-day 12-hour axle load survey on the road;
 - Measure the deflection at each FWD point on the marked sections; and
 - Measure the roughness of each section using a MERLIN.
- procure the equipment needed for the monitoring programme including:
 - Nuclear gauge;
 - Mobile weighbridge;
 - MERLIN device for measuring roughness;
 - Calibrated wedge to be used in rut depth measurements; and
 - Skid resistance apparatus.

Once the appointment has been made of the person in DRRD/RDU that is responsible for the project, an indicative programme will be agreed to undertake the various monitoring activities in a time-bound and accountable manner before the next CDS visit. After the next training input a recommendation will be made for a structured monitoring programme to be followed by the RDU.

Annex I – Participants in Kick Off Meeting

NAME	DESIGNATION	ORGANISATION
Soe Tun Naing	Director (RDU member)	DRRD/MOC -Head Office, Nay Pyi Taw
Kyaw Min Naung	Deputy Director	DRRD/MOC – Head Office, Nay Pyi Taw
Akare Zaw	Junior Engineer	DRRD/MOC – Head Office, Nay Pyi Taw
Myat Su Win	Junior Engineer	DRRD/MOC – Head Office, Nay Pyi Taw
Khet Wai Myint	Junior Engineer	DRRD/MOC, Shan state
Honey Pyaye Sone Thet Cho Oo	Junior Engineer	DRRD/MOC, Shan state
Ay Mee Khin	Sub Assistant Engineer	DRRD/MOC, Shan state
Honey Tun	Sub Assistant Engineer	DRRD/MOC, Shan state
Hnin Pwint Wai	Sub Assistant Engineer	DRRD/MOC- Head Office, Nay Pyi Taw
Wutt Hmone Win	Sub Assistant Engineer	DRRD/MOC – Head Office, Nay Pyi Taw
Zaw Zaw	Sub Assistant Engineer	DRRD/MOC Monghsat Township, Shan state
Aung Htay Min	Sub Assistant Engineer	DRRD/MOC Lashio Township, Shan state
Ye’ Thaug Htut	Deputy Team Leader/Liaison Officer for RDP	Gauff Ingenieure
Gniev Phally	ATL/Cost and Quality Control Engineer for RDP	Gauff Ingenieure
Nyan Lin Htun	Geologist, RDP	Gauff Ingenieure
Maysam Abedin	ReCAP Regional Technical Manager Asia	Cardno
Nandar Kyaw	Technical Manager - Myanmar	Cardno
Robert Geddes	Project Director	CDS
Michael Pinard	Materials Expert	CDS
Pham Gia Tuan	Trials Monitoring Engineer	CDS

Annex 2 – Traffic Count Form

(The form below will be provided to DRRD in MS Word format. Modifications are required for 24-hour traffic counts and if roads are carrying types of vehicle that are not included).

Road Name				Name of Inspector				Date														
Location of survey				Direction of travel to:				Day		Mon	Tues	Wed	Thurs	Fri	Sat	Sun						
Weather		Heavy rain	Light rain	Dry	Form Number:				of													

Time	Pedestrian	Bicycle	Motorcycle	Motorcycle with trailer	Ox cart	Hand tractor	Agricultural tractor	Car/saloon	SUV/4WD	Pickup	2-axle truck laden	2-axle truck unladen	3-axle truck laden	3-axle truck unladen	4-axle truck laden	4-axle truck unladen	5 and 6-axle truck laden	5 and 6-axle truck unladen	Total Non-motorised vehicles	Total Motorised vehicles		
06:00 - 07:00																						
07:00 - 08:00																						
08:00 - 09:00																						
09:00 - 10:00																						
10:00 - 11:00																						
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19:00-20:00																						
20:00-21:00																						
21:00-22:00																						
TOTAL																						