AsCAP
Asia Community Access Partnership

UKaid
from the British people

Review Workshop

Low Volume Rural Road Standards and Specifications in Myanmar

Workshop Report MYA2118B

NAY PYI TAW

24 January 2018

Rob Dingen
Tara Sann

Cover Photo: Rob Dingen

Quality assurance and review table			
Version	**Author(s)**	**Reviewer(s)**	**Date**
1.0	Rob Dingen, Tara San	Nandar Kyaw	31/01/2018
		Mayam Abedin	01/02/2018
		Les Sampson	02/02/2018

ReCAP Project Management Unit

Cardno Emerging Market (UK) Ltd

Oxford House, Oxford Road

Thame

OX9 2AH

United Kingdom

Abstract

This Review Study is the first phase of a two-phased project: Phase 1 – Review study to identify and comment on the existing specifications and standards and Phase 2 – Development of improved rural road standards and specifications and design guidelines. This study is managed and funded by AsCAP on behalf of the Department of Rural Road Development (DRRD) in the Ministry of Construction.

The aim is to develop a Myanmar specific Design Manual with appropriate low volume rural road standards and specifications.

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

Key words

Workshop, Low volume rural roads, standards, specifications.

Acknowledgements

We would like to acknowledge the contribution of the AsCAP partner DRRD and particularly the staff in the district and provincial offices of DRRD, the MOC staff and external organisations and institutions for their very active participation and deliberations.

Acronyms, Units and Currencies

ADB	Asian Development Bank
AfCAP	Africa Community Access Partnership
AsCAP	Asia Community Access Partnership
CBR	California Bearing Ratio
CRRN	Core Rural Road Network
DRD	Department of Rural Development (DOALI)
DRRD	Department of Rural Road Development (MOC)
Jica	Japan International Cooperation Agency
KfW	Kreditanstellung für Wiederaufbau (German Development Bank)
LVRR	Low Volume Rural Roads
LVSR	Low Volume Sealed Roads
MCEA	Myanmar Construction Entrepreneur Association
MES	Myanmar Engineering Society
MOALI	Ministry of Agriculture, Livestock and Irrigation
MOBA	Ministry of Border Affairs
MOC	Ministry of Construction
NCDDP	National Community Driven Development Project
NCDP	National Comprehensive Development Plan
NSRRA	National Strategy for Rural Road and Access
ORN	Overseas Road Note (by Transport Research Laboratory TRL), UK
PMU	Project Management Unit
RECAP	Research for Community Access Partnership
RRAP	Rural Road and Access Project-DRRD with ADB funding

TRL	Transport Research Laboratory
UKAid	United Kingdom Aid (Department for International Development, UK)
WB	The World Bank

ASIA COMMUNITY ACCESS PARTNERSHIP (AsCAP)

Safe and sustainable transport for rural communities

AsCAP is a research programme, funded by UK Aid, with the aim of promoting safe and sustainable transport for rural communities in Asia. The AsCAP 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 programme follows on from the earlier Southeast Asia Community Access Programme (SEACAP) that ran from 2004 to 2009. AsCAP is brought together with the Africa Community Access Partnership (AfCAP) under the Research for Community Access Partnership (ReCAP), managed by Cardno Emerging Markets (UK) Ltd.

See www.research4cap.org

Table of Contents

List of Figures

List of Tables

Annexes

1 Introduction

1.1 Rationale

Myanmar rural road standards and design specifications are in development with the aim to help the design engineer to make informed choices in geometric dimensions, design of pavement and structures, use of construction materials and methods of construction. The specifications need to be appropriate for the road environment and designed for actual and specific road users. The design standards and specifications must yield cost effective and appropriate designs fitting the diverse micro-environments and climatic zones of Myanmar and provide sufficient flexibility to allow for environmentally optimised and cost-effective design.

1.2 Scope

The objective of the project is a review of existing LVRR technical standards, specifications and design guidelines, identify weaknesses and gaps of the existing standards, leading to recommendations on their upgrade and expansion within the current NRSSA classification framework. The project furthermore aims to develop cooperation and knowledge exchange links with parallel ADB and KfW rural access programmes The outcomes from this review phase is to contribute to a separate but related wider DRRD-AsCAP aim which is the development of an effective LVRR Design Manual.

The scope of the project is therefore to produce findings on existing Myanmar LVRR standards and specifications; and outline which standards and specifications could benefit from further refinement and possible improvement to allow flexibility and fit for purpose design, but learning from international practice.

2 Workshop Proceedings

2.1 Organisation

A one-day Review Workshop was hosted by the Department of Rural Road Development of the Ministry of Construction in Park Royal hotel in Nay Pyi Taw, Myanmar, on 24 January 2018. The workshop was supported by AsCAP and facilitated by the project consultants Mr Rob Dingen and Ms Tara Sann.

2.2 Attendance

The workshop was attended by 82 participants from DRRD, MOC, ReCAP/AsCAP, universities, donor organisations and project consulting firms. The opening address of the workshop was given by the Deputy Minister of MOC, HE

2.3 Programme

The programme included (i) a presentation on the need for flexible standards in design of Low Volume Rural Roads, (ii) presentations of findings, (iii) two group working sessions in which the participants were invited to deliberate on the existing standards and suggest additions and possible improvements and topics to be included into a LVRR design manual. The workshop was concluded with an outline of the way forward towards developing a LVRR design manual. The programme is shown in Figure 1.

Time	Description	Presenter	Facilitator
Session 1: Opening Address			
08:30 – 08:50	Welcome / Opening Address	Deputy Minister MOC	DRRD
08:50 – 09:00	Group photo	-	Tara Sann
09:00 – 09:15	Overview of the ReCAP/ASCAP programme	Mr. Les Sampson	AsCAP
09;15 – 09:45	*Coffee/Tea Break*		
Session 2: Workshop Overview and Background			
09:45 – 09:55	Self-introduction participants		Tara Sann
09:55 – 10:20	Program and Objectives of the Workshop	Rob Dingen / Tara Sann	AsCAP
	Introduction to the Project		
10:20 – 10:40	Development LVRR Standards in the context of the ReCAP cooperation with the DRRD-ADB-RDP	Dr Jasper Cook	AsCAP
Session 3: Report on Review of Standards and Specifications			
10:40 - 11:10	• Defining standards and specifications • Findings from field observations • Review of existing standards and specifications	Rob Dingen / Tara Sann	AsCAP
11:10 – 11:45	Group work on appropriateness of standards		
11:45– 12:00	Presentation, Conclusion and Discussion		
12:00 - 13:00	*Lunch Break*		
Session 4: Development of Standards for Low Volume Rural Roads			
13:00 - 13:45	• Defining LVRR in the Myanmar context • Reference manuals vs existing standards • Defining the boundaries of development of standards	Rob Dingen	Tara Sann
	Clarification and Discussion		
Session 5: Validation of findings and recommendations			
13:45 – 14:30	Group work on development of design standards and technical specifications: What is needed? 1) Standards (geometric, pavement and drainage) 2) Technical specifications	Groups	Rob Dingen / Tara Sann
14:30 – 15:00	Report back from the groups	Participants	
	Plenary discussion	-	
15:00 - 15:30	*Coffee/Tea Break*		
Session 6: The way forward: Outline proposal for Phase 2			
15:30 - 16:00	Outline Project Proposal for Phase 2 • Implementation Strategy • Project management arrangement • Action plan	AsCAP	Rob Dingen / Tara Sann
Session 7: Wrapping up and closure			
16:00 - 16:30	Summary and workshop evaluation	Consultant	Rob Dingen / Tara Sann
	Closing remarks and the way forward	AsCAP	
	Closing of the workshop	DRRD	

Figure 1: Workshop Programme

3 Deliberations and Conclusions from the workshop

3.1 Opening Remarks

3.1.1 Opening Address by U Kyaw Lin, Deputy Minister, Ministry of Construction

The opening address of the workshop was delivered by His Excellency, U Kyaw Lin, Deputy Minister, Ministry of Construction. He stressed the vast scope of the challenge for Myanmar to upgrade and maintain access for 63,889 villages, of which 14% have no access to a road at all and 36% are only benefiting from dry season basic access. Only 22% of all registered villages are connected to higher level roads. The Ministry has developed a national strategy to achieve the national goals in providing access to all people. The Deputy Minister outlined the importance of quality control and research and the need for climate resilience technical designs. A Research Development Unit and the Rural Road Research Technical Committee (RRRTC) together with line ministries and external stakeholders will all contribute to the development of appropriate standards and specifications. As a final remark he wished the workshop participation to be active and suggested that attention is paid to a difficult issue of the road reserve (right of way) standards.

3.1.2 Opening Remarks by RECAP Team Leader, Mr Les Sampson

The speaking notes of ReCAP Technical Team Leader, Mr Les Sampson, are included in Annex 4. Les outlines the RECAP background and programme objectives and explains the structure of the management. Specific attention is paid to the three principle research targets of the programme: (i) Provision of rural access (construction), (ii) Preservation of access (maintenance), (iii) Effective use of rural access (transport services and mobility) and the cross cutting issues that are supporting these targets, such as capacity development, knowledge management and gender balance.

In Myanmar, ReCAP supports the development of a business plan for the Research Development Unit, and the Review of Low Volume Road Standards and Specifications, discussed during this workshop. A potential additional project is being prepared to introduce the DCP-DN design method in Myanmar.

3.2 Setting the Scene – by Dr Jasper Cook

The presentation, embedded into the presentations in Annex 2, provides an overview of what LVRR design requires. The starting point is that Low Volume Rural Roads (LVRR) are to be design to 'fit for purpose'. In contrast to a highway design principle, the LVRR design is adapted to fit the local road environment. Design standards therefore require flexibility to accommodate this.

The design standard for a LVRR is set such that there is an optimum reached at which the lifespan costs are lowest. This is influenced by initial construction costs, maintenance costs and road user costs. The road environment impacts on each of these parameters (see figure in the presentation)

Variable road environments with different terrain constrains, construction material availability and climate conditions demand for local solutions, so that LVRRs can be design and maintained cost-efficiently, serving the purpose of the road: providing sustainable all season access.

3.3 Review of Standards and Specifications – by Mr. Rob Dingen

3.3.1 Summary of presentations

The presentations (Annex 2) provide an overview of the different road environments of specifically Ayeyarwady Region and Shan State South as examples of two very different areas in Myanmar with region typical constrains in terrain, climate, hydrology and soil conditions, leading to the conclusion that diversification of standard designs are needed to address these differences adequately.

This is followed by a review of existing standards and specifications currently in development, and a comparison of draft DRRD standards with standards from ORN 31, and standards from Cambodia and Laos. The current standard drawings are set at assumed traffic classes to a maximum of 500 ADT and pavement design assumes a weak subgrade of maximum 4%. The assumed maximum design life Equivalent Standard Axle (esa) load is set at 300,000. For the highest category (class A road) this shows (table 1):

	DRRD	RDP (Shan South)	Cambodia/Laos KfW-RIP
Traffic Class	T1,T2	T1~T5	T1~T5
esa	0.3×10^6	up to 1 million	up to 1 million
ADT	<500		<2000
Axle load	not provided, but ORN31: 8.1t	8-10 t	4.5 t (LVRR), 4.5-10 t
Subgrade	S1, S2 (up to 4%CBR)	all subgrades	all subgrades
Carriageway width	5.5m (Class A) (3.5m for Class B, C)	4.5 m	2.5-5.5m
Type of pavement:	Macadam/DBST/CC	DBST/Penmac/CC	GWC/DBST/CC
Pavement layers	Boxed to carriageway width	full width	full width
Shoulder width	3m (Class A) (1.2m for Class B, C)	1 m	1 - 1.5m

Table 1: Class A- Comparison of design standards

These standards may result in *over*-design of pavement in road environments with a strong subgrade and a possible *under*-design of roads in weak subgrades and where the actual traffic is over and above the design traffic.

3.3.2 Outcome of group work by Topographic/ Climatic Zone

The participants were invited to break out into three groups, representing the Delta areas, the Dry areas and the Mountainous areas. The groups were asked to deliberate and conclude on the need for diversification and development of standards and specifications. Figure 1 shows a collage of the flipcharts presented by the groups and table 2 presents the questions and the transcribed answers provided by each group.

The general consensus of all groups was that further diversification of standards taking account of local conditions, would be beneficial to more appropriate and cost-effective design of rural roads. There is a recognition that flexibility is needed in terms of legal road reserves and relaxation of standards are required to allow for appropriate designs of narrow and steep road sections. The groups also recommend refining standards to take account of in-situ subgrade strengths and quality of materials. Pavement types should not be restricted, if these are cost effective and best suit the local road environment and road task.

There is a further understanding that standards set for functional classes A, B, C are not necessarily appropriate under all circumstances; In some cases for example, traffic on a B-class road can be higher than on an A-class road and that appropriate geometric and pavement standards would need to be determined for these situations.

Particular road evironments in Shan, Magwy and Chin States were raised as examples where traffic can be heavy, but the standards for alignment, the subgrade strength and the road width are insufficiently tailored to the local conditions. Also Ayeyarwady was mentioned as a special case, as regular flooding occurs and embankments and road subgardes are insufficiently resilient. Standard designs may need to be further refined to cater for these local differences.

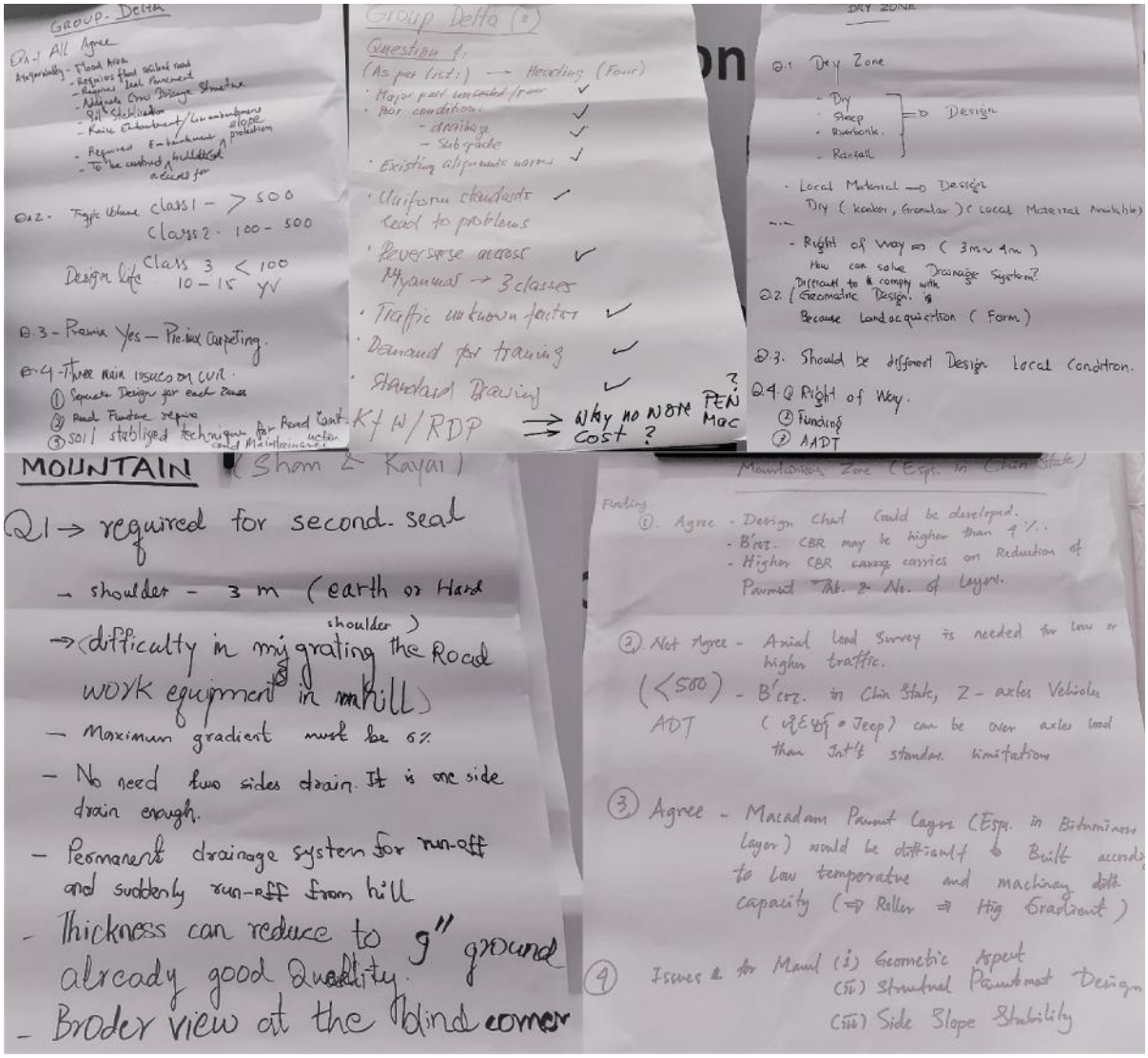


Figure 2: Group results from deliberations on standards and specifications

Questions	Dry Zone	Delta areas	Mountainous areas
1. Do you agree that the existing road design standards and specifications in Myanmar require differentiation for different road environments and road tasks? Please elaborate	- Diversification of design standards are needed taking account of dry/wet areas, Steep/flat terrain (hill and flat cross sections, granular/plastic soils, Riverbanks / protection, - Rainfall (climate change safety factors, Return periods, hydraulic design. - Local Materials Design for Kanker, Granular pavements (Locally Available) - Road width (3m – 4m) restricts space for drainage system	- Design charts needed for Geometric, pavement, Hydraulics, Structural standards - Most roads are unsealed, in poor condition, lack drainage, weak subgrade. - Existing Alignments are narrow: uniform standard lead to problems with road reserve standards, land acquisition. Reverse Across Myanmar - 3 classes - Traffic is an unknown factor but need to determine geometric standards	-Design chart should be developed to differentiate in subgrade strengths. CBR may be higher than 4% and requires less thick pavement design / fewer layers Design required for: - second seal layer - shoulder of 3 m (earth or hard shoulder), depending on road safety and available space - one side hill drain on slopes, catchwater drains and protection works; variations in standard cross sections needed -Maximum gradient should be designed at < 6%, but variations possible in hard rock. Adjust pavement to gradient. - Attention to sight lines in blind comers: horizontal and vertical minimum curves.
2. The geometric and pavement design standards currently under preparation for DRRD consider a maximum traffic of 500 vehicles per day (geometric design) and a maximum of 0.3 MESA (pavement design) over the road design life? Are these thresholds appropriate?	- Difficult to comply with Geometric Design due to required road reserve, requiring land acquisition (of farm land). Relaxation of road reserve standards are needed	Three classes are proposed based on traffic volume: class 1: > 500 ADT, class 2: between 100 and 500 ADT class 3: < 100 ADT Proposed Design life 10–15 years, depending on class	For the mountains, these are not appropriate. CBRs generally much higher than the assumed CBRs. No need for over design. But axle load surveys are needed for low or higher traffic and appropriate design standards need to be developed for different traffic classes; (lower and higher than 500 ADT – In Chin State, 2 axle Vehicles (Hine Mon- Jeep) can be above the international accepted axle load.
3. Should there be more options for pavement design? Which?	- Yes, tailored to local conditions, see above	Penetration Macadam should be considered as an option. Pre-mix and pre-mix carpeting	Macadam Penetration Pavement difficult to construct in low temperature conditions. Difficult also for necessary machines to manoeuvre on narrow and steep roads. Take account of implementation conditions in the design of standards.

4. Name at least three main issues of LVRR design in Myanmar that should be addressed by a LVRR manual?	(i) Right of way (ii) Funding / planning (iii) AADT design base	- Demand for training - Design for flood resilient including submersible structures, -Hydraulic and structural design of cross drainage, - embankment protection, - Refining design standards for each climatic and topographic zone / condition, - Road furniture designs - Soil stabilisation techniques for road construction & maintenance.	(i) Geometric design charts, including standards for hill sections (ii) Structural Pavement Design charts (iii) Side Slope Stability (cut/fill, environmental protection)

Table 2: Feedback from groups on existing standards and specifications

3.4 Development of Standards and Specifications – by Mr. Rob Dingen

3.4.1 Summary of presentations

The presentation in Annex 2 outlines the history of LVRR manual development in Africa and explains that home grown manual development take time and various steps and updates. The presentation includes a comparison of LVRR Manuals from Tanzania, with a moderately broad scope, a Design Manual from Malawi, with a narrow scope and a Manual from Laos, specifically developed to cater for the smaller LVRR with light traffic (Annex 3). The overview shows the different design standards developed for these different environments and compares geometric, drainage and pavement design.

Following this session, the participants were asked to break out in three groups and discuss and answer questions related to Geometric, Hydraulic and Pavement design.

3.4.2 Outcome of group work –Geometric, Pavement, Hydraulics/ hydrology

The general consensus of all groups was that further diversification of standards taking account of local conditions, would be

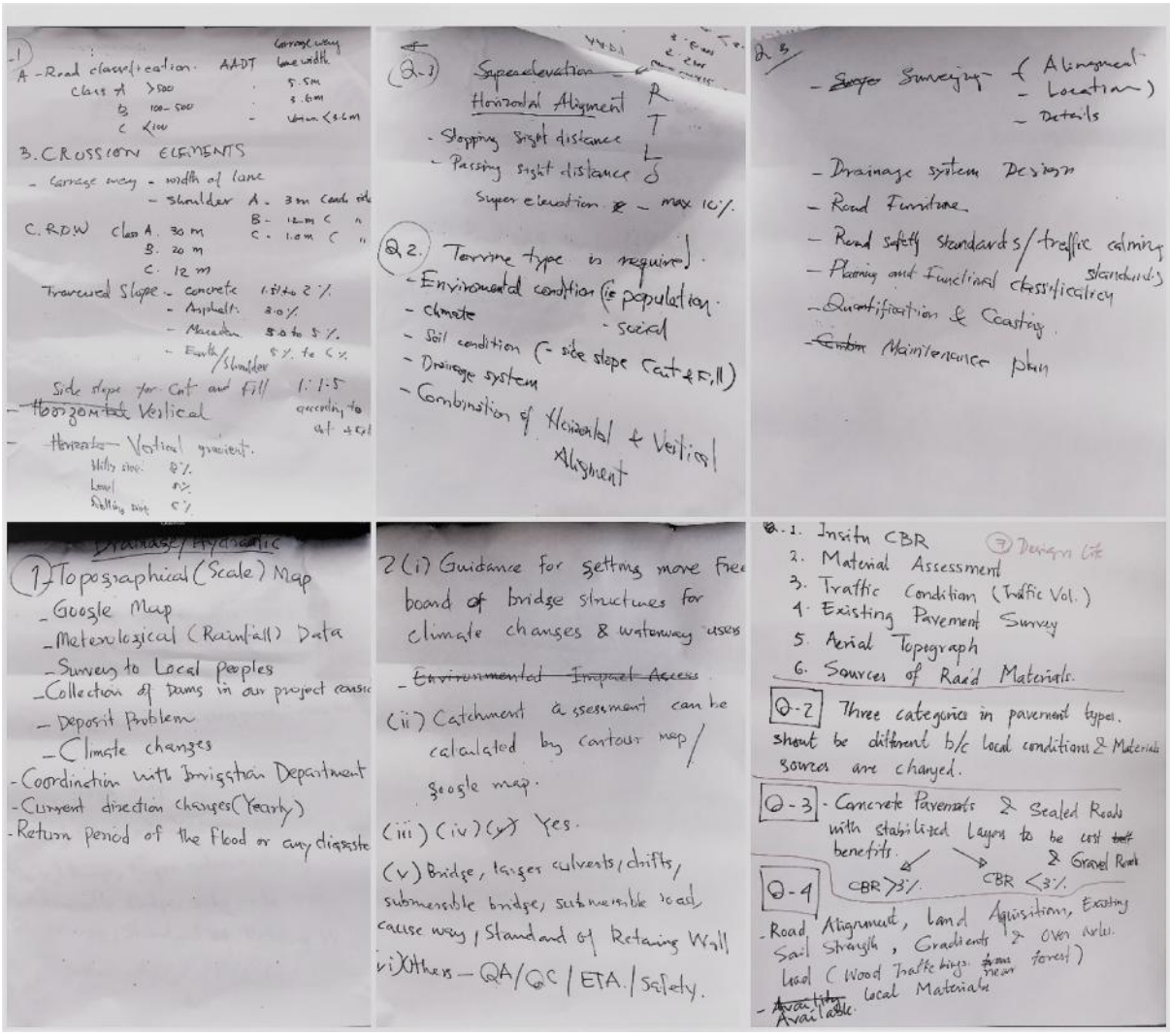


Figure 3: Results from group deliberations on the development of a LVRR Manual

<table>
<tr><th>Questions on Geometric standards</th><th>Feedback</th></tr>
<tr><td>1. In view of what is needed for your work as rural road design engineer, what subjects should be included in a Low Volume Rural Road Design Manual related to geometric design? Please elaborate</td><td>Attention to road safety aspects:
- Horizontal and vertical alignment fitting appropriate design speeds
- Stopping and passing sight distances (in curves); this also relates to the road reserve, vegetation and objects that obstruct sight

The group listed the Existing standards:
<table><tr><td>Road class</td><td>AADT</td><td>Carriageway width</td><td>Right of Way</td></tr><tr><td>Class A</td><td>> 500</td><td>5.5 m</td><td>30 m</td></tr><tr><td>Class B</td><td>100- 500</td><td>3.6 m</td><td>20 m</td></tr><tr><td>Class C</td><td>< 100</td><td>Varies < 3.6 m</td><td>12 m</td></tr></table>
Crossing Element
Shoulder A – 3m (each side)
Shoulder A – 1.2 m (each side)
Shoulder A – 1.0 m (each side)

Crossfall:
– Concrete: 1.5 % to 2 %
– Asphalt (DBST) 3.0 %
– Macadam 3.0 % to 5 %
– Earth / Shoulder 5 % to 6 %
Super elevation max 10 %

Side slope for cut/fill 1:1.5
Vertical gradient
Hills max 8%
Rolling max 6%
Flat max 5%
No further suggestions were made for inclusion</td></tr>
<tr><td>A. Is the network tier (level in the hierarchy) sufficient to set the geometric design standard? (Class 1, 2 and 3 rural roads), or should there be a differentiation by terrain type, soil condition (road environment), road task / traffic? Any other considerations?</td><td>The design standards should differentiate in:
- Traffic volumes and type of traffic
- Terrain Type (steepness and Side Slope Cut and Fill)
- Demography, and purpose of the road (Population and Social)
- Climate (rainfall, temperature)
- Soil Condition
- Drainage system
- Combination of Horizontal & Vertical Alignment</td></tr>
<tr><td>B. In addition to the geometric standards, should the future manual include a wider scope?</td><td>- Planning and Functional Classification
- Surveying (Alignment, Location and Detail)
- Drainage system Design
- Road Furniture
- Road Safety Standards/ Traffic calming standards
- Quantification & Costing
- Maintenance Planning and costing and prioritisation</td></tr>
</table>

Table 3: Feedback on Geometric LVRR Standards

Questions on Drainage & Hydraulic design standards	Feedback
1. In view of what is needed for your work as rural road design engineer, what subjects should be included in a Low Volume Rural Road Design Manual related to hydrological analysis and hydraulic design? Please elaborate	- Topographical (Scale) Map - Google Map and use of GIS tools - Meteorological (Rainfall) Data analyses - Survey / information gathering from local people - Use of and design of small dams - How to deal with spoil of unsuitable materials - Climate Change assessment and effects - Coordination with irrigation Department - Current direction changes (Yearly) - Catchment analyses and setting of Return Period of floods or any disaster.
2. Provide feedback on the following subjects; should it be included and should it vary by road class? (i) How should climate change impact be accommodated in the manual? (ii) Catchment assessments? (iii) Hydraulic design of side drains and structures? (iv) Hydraulic design of cross drainage (bridges, larger culverts, drifts, etc) (v) Construction standards for structures? (vi) Other?	(i) Guidance on setting of safe freeboard of bridges, taking account of climate changes & waterway transport (ii) Catchment assessment can be calculated by contour map / Google map (iii) Yes (iv) Yes (v) Yes (vi) Standards for bridges, larger culverts, drifts, submersible bridges, submersible road, causeway, retaining wall (vii) Quality Assurance and Control, Environmental Impact Assessment, road safety

Table 4: Feedback on Hydraulic and drainage LVRR Standards

Questions on Pavement Standards	Feedback
1. In view of what is needed for your work as rural road design engineer, what subjects should be included in a Low Volume Rural Road Design Manual related to design? Please elaborate	- In situ CBR - Material Assessment and Source of Road Materials - Traffic Condition (Traffic Volume and axle load), prediction - Existing Pavement Survey - Aerial Topography - Design Life
2. Should there be standard pavement types for the three rural road categories, or should there be differentiation in pavement even within the three categories?	Three categories in pavement types should be different because local conditions & materials sources vary. More differentiation is needed for different terrain and conditions
3. What pavement types could you think of? Which should be included in the LVRR manual?	Concrete pavements & Sealed Roads with stabilized layers to be designed, based on cost-benefit analyses and Gravel Roads should be included as options in areas where there are suitable local materials. Pavement designs for CBR subgrade less than 3% and classes of pavement design for in situ CBR of over 3%
4. What factors would influence the choice of pavement? How do these play a role in the different terrain and climatic environments in Myanmar	- Road Alignment, Land Acquisition, Existing subgrade strength, Gradients & Axle (over) load (Timber transport evacuating from forest areas) - Availability of local materials

Table 5: Feedback on Pavement LVRR Standards

3.5 The Way Forward

3.5.1 Developing a LVRR Design Manual

As explained at the start of the workshop, the review of standards and specifications of LVRRs is the first step in the project. Following the review is the development of a LVRR Design Manual fitting the diverse conditions in Myanmar.

The first step is to finalise the review report and outline a programme of development for the manual. AsCAP intends to support this development through a service provider. The final review report will also outline the strategy for the Design Manual development. Pros and cons were discussed of the development of a full manual versus the development of technical design guidelines. The consensus seems to be to develop a manual in a staged approach with areas of priority (and urgency) as discussed in section 3.4.

3.5.2 Closing Remarks by U Khin Thet, Director General of DRRD, MOC

The DG thanked all participants for their active participation and hard work and continued saying that there is a great need for research in the rural road sector, particularly as Myanmar has such diverse terrain and climatic conditions and vulnerable roads. U Khin Thet expressed the wish that the workshop will contribute to the development of rural road standards and a design manual and in close coordination with ReCAP, line ministries and universities and other development partners. The speech is included in Annex 4.

4 Workshop Evaluation

The participants were asked to complete an evaluation form and asked to state how useful they thought the workshop was and to elaborate this statement with a comment. The form also asked to rate each session with a score for interest and provide comments. The final question was to express interest in contribution to the development of a manual and how.

The participants were grouped in:

A. Academic or professional body
B. Ministry level
C. State and District DRRD staff
D. Donors and Consultants

There were 38 respondents. Almost all participating DRRD field staff have submitted a filled form. There was only 1 respondent in Group D (Consultants / Development partners). This score is left out from the evaluation. See Annex 5 for Details. In summary, on a scale from 1 (bad) to 10 (excellent), the average sessions scores are presented in table 6, visualised in figure 4.

There was a clear appreciation of the workshop and especially of the working group sessions.

Session/topics		Overall	Average A	Average B	Average C
1. How useful was this workshop?	*Very Useful*	55%	29%	50%	67%
	Useful	45%	71%	50%	33%
	Not so useful	0%	0%	0%	0%
2. Setting The Scene (by Dr Cook)		7.2	7.6	7.0	6.9
3. Findings from the review (presentations)		7.2	7.5	7.5	7.0
4. Group work on standards and specifications		8.1	8.3	7.3	8.6
5. Outline for phase 2: Development of a LVRR manual for Myanmar		7.0	7.3	6.7	7.0
6. Action Plan and arrangements		6.8	7.0	6.7	7.0
7. Would you like to be involved in the development of the guidelines or manual for LVRR in Myanmar	*Yes*	95%	100%	100%	89%

Table 6: Evaluation Results

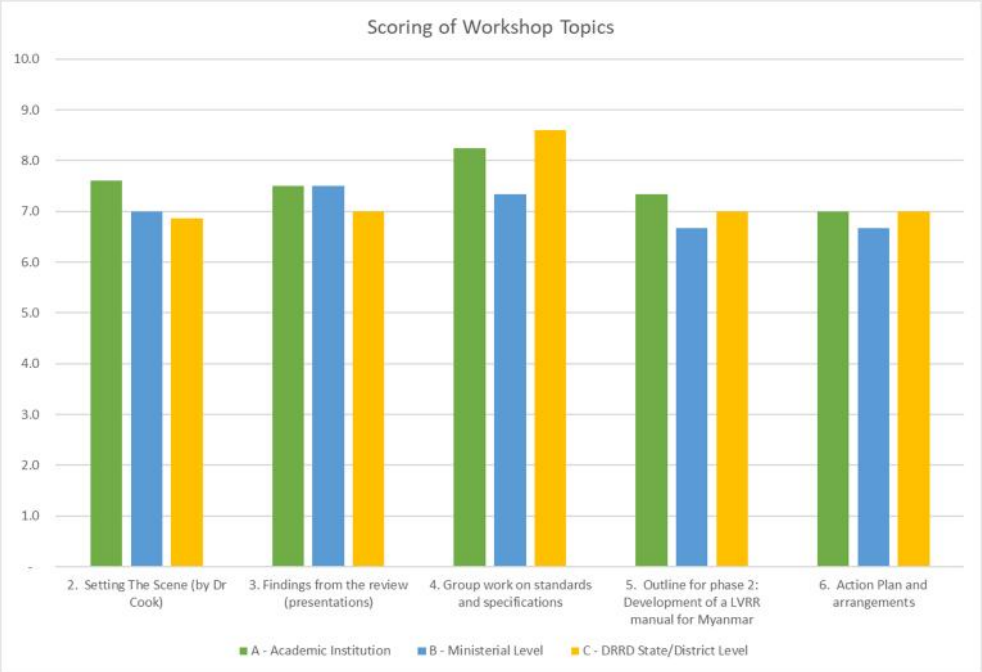


Figure 4: Evaluation results by topic and respondent group

Annex 1: Participants

Workshop Attendance List

No.	Name	Title	Department, Organization
	ReCAP		
1	Dr. Jasper Cook	Chief Scientific Advisor	ReCAP
2	Maysam Abedin	Regional Technical Manager	AsCAP
3	Mr. Les Sampson	Technical Team Leader	ReCAP
4	Dr Nandar Kyaw	Country Manager	AsCAP (Myanmar)
5	Mr. Rob Dingen	Project Team Leader	Consultant for AsCAP
6	Ms.Tara Sann	Project Consultant	Consultant for AsCAP (support)
Academic/Professional Body			
7	Dr. Yin Yin Htwe	Lecturer	Mandalay Technological University
8	U Sann Win Maung	Lecturer	Pathein Technological University
9			
10	U Htay Win	Associate Professor	Yangon Technological University
11	Daw Kyaing	Lecturer	Yangon Technological University
12	Dr. Win Zaw	Director	Taunggyi Technological University
13	Dr. Kay Thawe Htun	Professor	Madalay Technological University
14	U Win Htay	Director (NPT)	Myanmar Engineering Society
15	U Aung Myo Tun	Director	Myanmar Engineering Society
Department of Rural Road Development, MOC			
16	U Kyaw Linn	Deputy Minister	Minister Office, Ministry of Construction
17	U Wint Tint	Permanent secretary	Minister Office, Ministry of Construction
18	U Khin Thet	Director General	Department of Rural Road Development, Ministry of Construction
19	U Min Htein	Director General	Ministry of Construction
20	U Aung Myint Oo	Director General	Department of Highways , Ministry of Construction
21	U Ohn Lwin	Director General	Department of Urban and Housing Development
22	U Myint Oo	Deputy Director General	Department of Rural Road Development, Ministry of Construction
23	Daw Tin Moe Myint	Deputy Director General	Department of Rural Road Development, Ministry of Construction
24	U Wanna Zaw	Deputy Director General	Department of Rural Road Development, Ministry of Construction
25	U Soe Soe Oo	Deputy Director	Department of Rural Road Development, Ministry of Construction

26	U Thet Nyo Oo	Deputy Director	Department of Rural Road Development, Ministry of Construction
27	Daw Thein Nu	Chief Engineer	Department of Bridge, Ministry of Construction
28	Daw Wai Wai Htut	Director (Admin)	Department of Rural Road Development, Ministry of Construction
29	U Win Thein	Chief Engineer	Department of Rural Road Development, Ministry of Construction
30	U Thein Oo	Director	Department of Rural Road Development, Ministry of Construction
31	U Soe Tu Nay	Director	Department of Rural Road Development, Ministry of Construction
32	U Zaw Aye	Deputy Director	Minister Office, Ministry of Construction
33	Dr. Tun Myint	Director	Department of Rural Road Development, Ministry of Construction
34	U Thein Than Htun	Deputy Director	Department of Rural Road Development, Ministry of Construction
35	Daw Kyi Kyi Thwe	Chief Engineer	Department of Rural Road Development, Ministry of Construction
36	U Win Shein Director	Director	Department of Rural Road Development, Ministry of Construction
37	U Ye Kaung Htun	Director (Finance)	Department of Rural Road Development, Ministry of Construction
38	U Soe Thiha	Officer	Department of Highway, Ministry of Construction
39	Daw Thandar Khaing	Sub Assistant Engineer	Department of Rural Road Development, Ministry of Construction
40	Daw Nyein Thant Yi	Accountant 3	Department of Rural Road Development, Ministry of Construction
41	Daw Htet Khaing Soe	Special Sub- Assistant Engineer	Department of Rural Road Development, Ministry of Construction
42	U Tin Yee	Director	Department of Rural Road Development, Ministry of Construction
43	U Tint Lwin	Director	Department of Rural Road Development, Ministry of Construction
44	U Nay Oo	District Engineer	Department of Rural Road Development, Ministry of Construction
45	Daw Wut Hmone Win	Sub Assistant Engineer	Department of Rural Road Development, Ministry of Construction
46	U Zaya Win	Assistant Engineer	Department of Rural Road Development, Ministry of Construction
47	Daw Aye Aye Soe	Director	Department of Rural Road Development, Ministry of Construction
48	U Ko Ko Aung	Director	Department of Rural Road Development, Ministry of Construction
49	Dr. Nilar Aung	Assistant Director	Department of Highway, Ministry of Construction
50	Daw Ei Kay Khine	Assistant Engineer	RTAD, Ministry of Transportation and Communication
51	U Tazar Myo Win	Deputy Director	Ministry of Agriculture, Livestocks and Irrigation
52	U Salai Su Kam Mon	Assistant Director (Yangon)	Department of Rural Road Development, Ministry of Construction
53	U Zaw Hlaing Win	Deputy Director	Ministry of Border Affaris
Department of Rural Road Development, MOC (States and Divisions)			
54	U Nay Myo Min	Staff Officer (Bago)	Department of Rural Road Development, Ministry of Construction
55	U Ye Thu Aung	Sub Assistant Engineer (Kayin)	Department of Rural Road Development, Ministry of Construction

56	Daw Lynn lynn Ohn	Assistant Director (Kachin)	Department of Rural Road Development, Ministry of Construction
57	Daw Thit Thit Aung	Assistant Director (Kayah)	Department of Rural Road Development, Ministry of Construction
58	U Yar Myunt	Assistant Director (Shan East)	Department of Rural Road Development, Ministry of Construction
59	U Kyaw Min Htoo	Assistant Director (Ayeyarwady)	Department of Rural Road Development, Ministry of Construction
60	U Zaw Win	Assistant Engineer(Mon)	Department of Rural Road Development, Ministry of Construction
61	Daw Aye Thizar Kyaw	Assistant Director (Kachin)	Department of Rural Road Development, Ministry of Construction
62	U Zayar Soe TInt	Assistant Director (Rakhine)	Department of Rural Road Development, Ministry of Construction
63	Daw Thea Zarchi Win	Senior Officer	Department of Rural Road Development, Ministry of Construction
64	Daw May Thu Kyaw	Special Sub- Assistant Engineer	Department of Rural Road Development, Ministry of Construction
65	Daw Khine Khine Soe	Assistant Director	Department of Rural Road Development, Ministry of Construction
66	U Thein San Hlaing	Deputy Director (Magway)	Department of Rural Road Development, Ministry of Construction
67	U Win Maung Swe	Assistant Director	Department of Rural Road Development, Ministry of Construction
68	U Win Myo Nyunt	Assistant Director	Department of Rural Road Development, Ministry of Construction
69	Daw Wut Hmone Win	Sub Assistant Engineer	Department of Rural Road Development, Ministry of Construction
70	Daw Mon Myat Aung	Assistant Director (Yangon)	Department of Rural Road Development, Ministry of Construction
71	U Myo Win Nyunt	Assistant Director (Taninthayai)	Department of Rural Road Development, Ministry of Construction
72	U Zayar Win	Assistant Director	Department of Rural Road Development, Ministry of Construction
73	Daw Thoe Zarchi Win	Assistant Director	Department of Rural Road Development, Ministry of Construction
74	U Sai Kyaw Han Htoo	Assistant Director (Mandalay)	Department of Rural Road Development, Ministry of Construction
75	Daw Nyeing Thant Ye	Assistant Director	
76	U Than Htun	Assistant Director (Chin)	Department of Rural Road Development, Ministry of Construction
77	Daw Hnin Pwint Wai	Sub Assistant Engineer	Department of Rural Road Development, Ministry of Construction
Developments partners & Consultants			
78	Mr. Yaga Baral	Infrastructure Manager	UNOPS
79	Mr. Delelegn Alemu Aulate	AQ manager	UNOPS
80	Mr. Maeda Hiroto	CORE project coordinator	CORE
81	U Nay Thawe	Operational Manager	CORE-DEAR Myanmar
82	Mr. Serge Cartier	ADB Consultant	Asian Development Bank
83	Mr. Kei Senoo	JICA expert	JICA
84	Mr. Mustafa Iqbal Azam	DRRD/ MOC Road Bridge Engineering	DRRD/ MOC
85	Mr. Andre Drockur	Team Leader RDP1	Gauff, KFW

86	Mr.Phally	Resident Engineer RDP1	Gauff, KFW
87	U Ye Thar Htun	Deputy Team Leader RDP1	Gauff, KFW
88	Dr Geoff Edmonds	Team Leader RRAP	SWE Road, ADB
89	Walter Illi	Design Engineer	SWE Road, ADB
90	Holger Gwosdz	PD/ Team leader	RRRP/ Kalaw
91	Joe Rolling	Country Manager	DFID / UK Aid representative
92	Daw Win Myint Than	Deputy Team Leader	ADB

Annex 2: Presentations

AFCAP / ASCAP
Africa/Asia Community Access Partnership

UKaid
from the British people

AsCAP
Asia Community Access Partnership

Review of Rural Road Standards and Specifications in Myanmar

Ministry of Construction
Department of Rural Road Development

Rob Dingen / Tara Sann

Cardno

AsCAP
Asia Community Access Partnership

Review of Rural Road Standards and Specifications in Myanmar

Workshop Programme:

Morning:

Session 1:	Opening Address and Introduction
Session 2:	Programme, Objectives and introduction to the project
Session 3:	Findings from the Review with group work on appropriateness of standards
Session 4:	Development of standards for LVRR in Myanmar

Afternoon:

Session 5:	Validation on the findings and development of standards, through group work
Session 6:	The way forward: outlining the development of guidelines and a manual.
Session 7:	Workshop evaluation and closure

AsCAP Asia Community Access Partnership

Review of Rural Road Standards and Specifications in Myanmar

Workshop Objectives:

- To brief the audience on the findings from the review
- To obtain views from the participants on the development process, outline and content of a LVRR Design Manual

AsCAP Asia Community Access Partnership

Review of Rural Road Standards and Specifications in Myanmar

Introduction to the project:

Phase 1 – Review study to identify and comment on the existing specifications and standards, and

Phase 2 – Development of improved rural road standards and specifications and design guidelines.

This study is managed and funded by AsCAP on behalf of the Department of Rural Road Development (DRRD) in the Ministry of Construction (MOC).

Phase 1 reviews the situation in Ayeyarwady and Shan South, as two examples of different road environments

AsCAP
Asia Community Access Partnership

Review of Rural Road Standards and Specifications in Myanmar

Introduction to the project:

- The review included field observations in Ayeyarwady and Shan South, including the proposed roads under the (ADB) Rural Road and Access Project (RRAP) in Ayeyarwady and the (KfW) Rural Development Project (RDP) in Shan South, both implemented by the DRRD, MOC. Other potential roads under WB funding were also looked at.
- The review held meetings with various stakeholders to obtain there views and suggestions related to the development of LVRR standards. Stakeholders visited included: the District and state offices of DRRD, the Myanmar Engineering Society, the Myanmar Construction Entrepreneur Association, the MOC Laboratory in Yangon, Jica, KfW,
- The consultant has collected and reviewed available standards and specifications under preparation by the MOC and reviewed a selection of guidelines and manuals from the region and African countries.

AsCAP
Asia Community Access Partnership

Review of Rural Road Standards and Specifications in Myanmar

Presentation on Development LVRR Standards in the context of the ReCAP cooperation with the DRRD-ADB-RDP

By Dr Jasper Cook

AFCAP / ASCAP
Africa/Asia Community Access Partnership

UKaid
from the British people

AsCAP
Asia Community Access Partnership

National Standards

A standard is a minimum level of quality that should be achieved at all times and nationwide. Amongst other things this ensures consistency across regions.

A national 'standard' is not a specification, although it could, and often is, incorporated into specifications and contract documents

Key Principle

The design, construction and maintenance of "Fit for Purpose" rural roads.

Common Purpose: all-season rural access for villages.

But the physical, climatic and socio-economic factors impacting that purpose may be different.

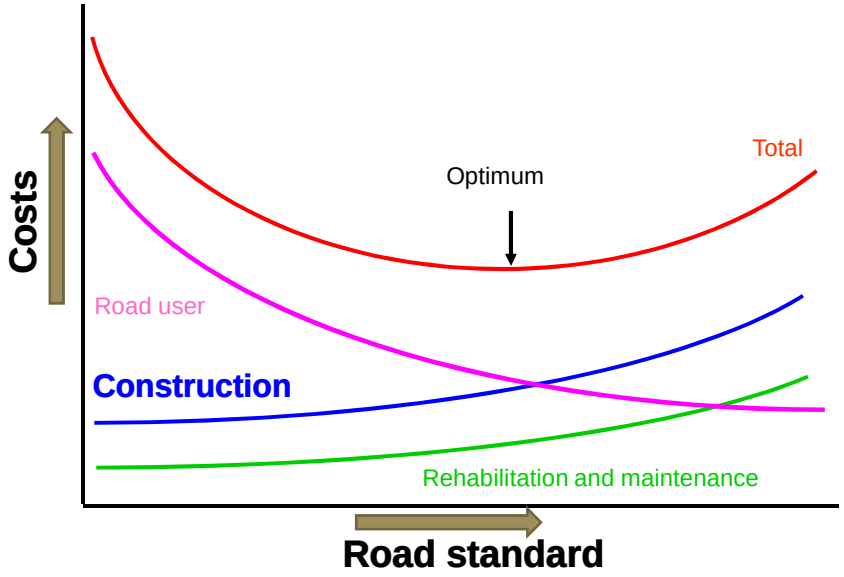
AsCAP

Standards: Aim

To ensure that roads within the Myanmar rural road network should be:

- Consistent with the Myanmar Rural Development Strategy
- Consistent with the various road environments in Myanmar
- Fit for Purpose
- Sustainable

Standards: Total transport costs

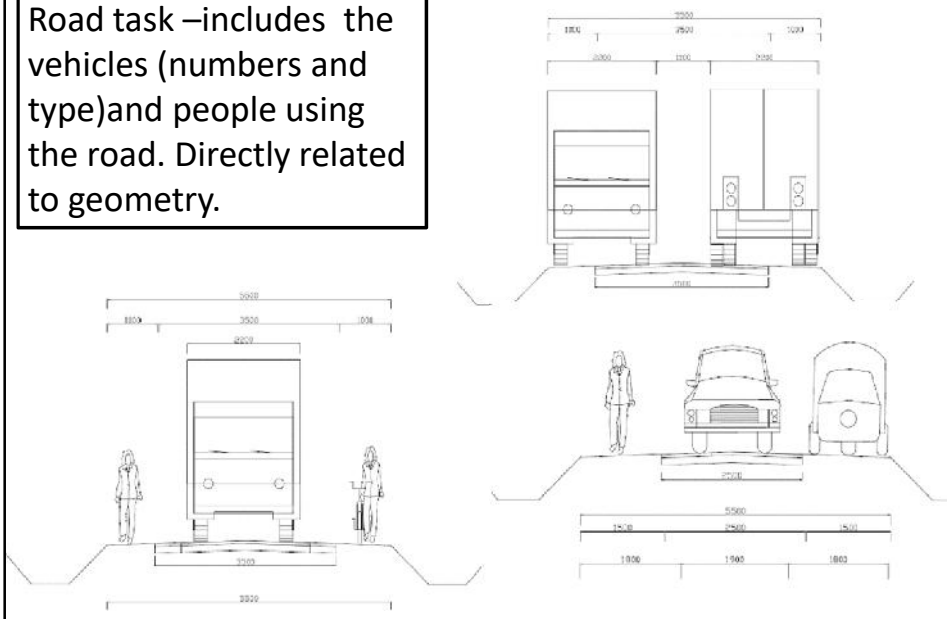


Considerations

An appropriate rural road design approach should ideally be based around a number of key technical elements:

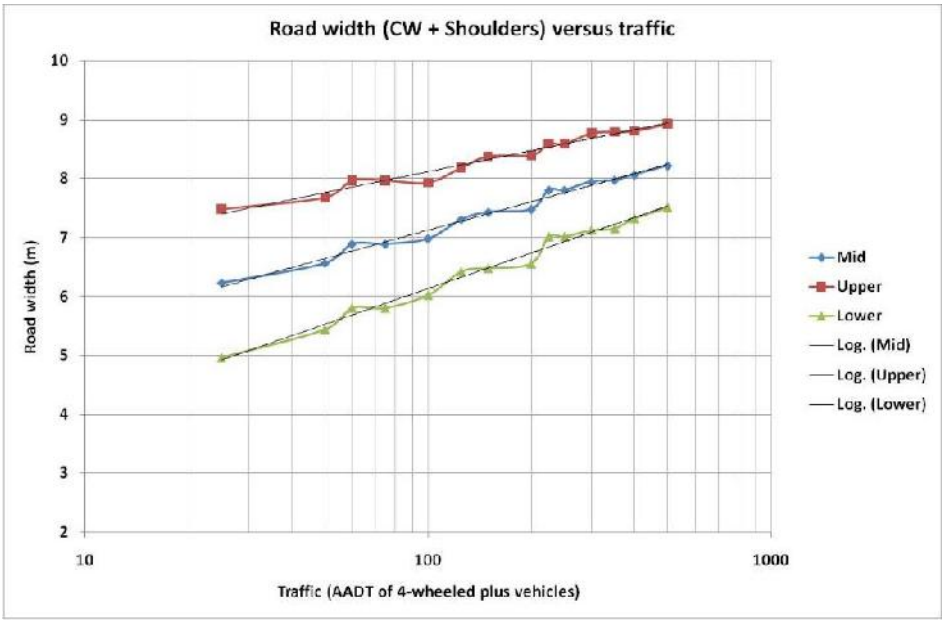
- Classification
- Standards
- Technical Specifications
- Design Manual

Road task –includes the vehicles (numbers and type)and people using the road. Directly related to geometry.



6

Road width comparisons (CW + shoulder)

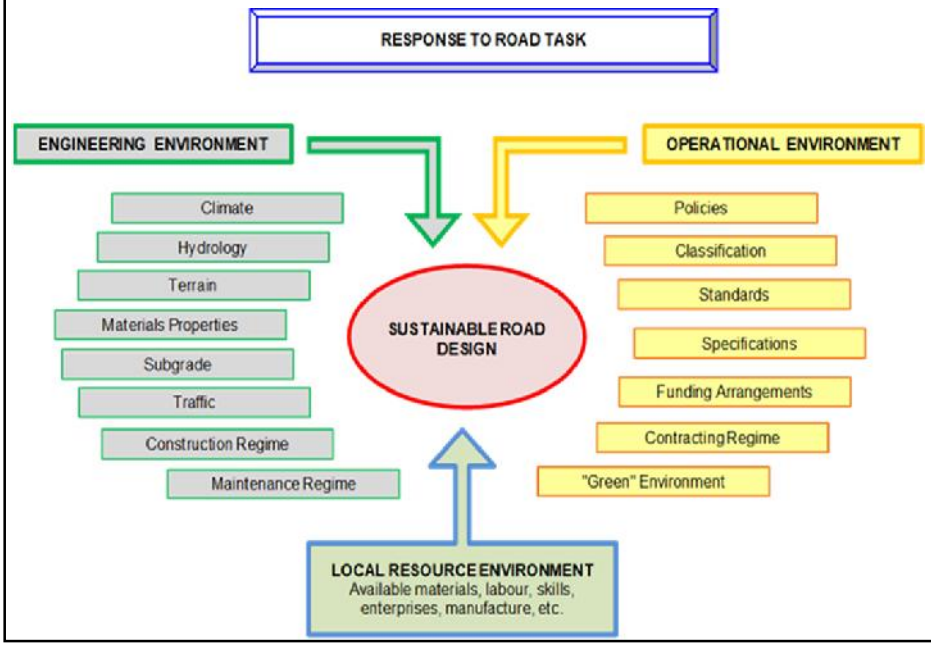


AsCAP
As a Common by Access Partnership

Current General Classification

Class	Traffic (esa) 1 way	Carriageway Width (m)	Shoulder Width (m)	Recommended Pavement Option
1	<300,000	5.5	3.0	Bitumen seal over crushed stone/gravel base & sub-base Un-reinforced concrete slab over crushed stone/gravel sub-base.
2	<300,000	3.6	1.2	Bitumen seal over crushed stone/gravel base & sub-base Un-reinforced concrete slab over crushed stone/gravel sub-base. Gravel wearing course over crushed stone/gravel sub-base.
3	Not defined	3.6	0.5-1.0	Gravel wearing course over crushed stone/gravel sub-base. Earthen road

The Rural Road Environment



AsCAP
As a Common by Access Partnership

Terrain

The terrain has obvious influence on the long section geometry (grade) of the access and consequently costs of construction and long-term maintenance.

In hilly and mountainous terrain we cannot afford to build roads to the same standards as in flat terrain.

The reduction in standards is based on cost but also largely on judgement

.

AsCAP

Hydrology

Water or, more specifically, its movement within and adjacent to the road structure has an over-arching impact on the performance of roads and associated drainage structures.

Myanmar is vulnerable to natural climatic disasters in terms of serious floods, extreme rainfall events or droughts depending on the location.

Climate change could additionally result in increases in this vulnerability

AsCAP

Climate Impact: Service Standards in term of access being cut

Road Class	Flood Event (Return Period)			
	5yr	10yr	50yr	100yr
National Highway	nil	Nil	<2 hrs	<12hrs
Provincial Highway	nil	<6 hrs	<1 day	<2 days
District Road	<2hrs	<12 hrs	<2 Days	<4 Days
Village Access	<12hrs	<2 Days	<4 Days	<7 Days
Farm Access	<1 Day	<4 Days	< 7 Days	<10 Days

AsCAP

Construction Materials

There areas of Myanmar where material reserves are limited or of marginal quality and their appropriate usage is a priority.

For rural networks the use of local materials is always a priority, and the issue must be; ‘what design options are compatible with the available materials?’

AsCAP

Construction Regime

The construction regime governs whether or not the rural access design is applied in an appropriate manner.

Key elements are issues such as the experience and skill of the contractors or construction groups; quality control and supervision. The selection of design options must either reflect the local contracting experience or be accompanied by construction training and trials

AsCAP

Variable Environments

Region	Terrain Constraints	Materials Issues	Climate Issues
Ayerawaddy	Flat; roads on embankment, limits to carriageway widening.	Long hauls for aggregate. Local soils may be used when stabilised	Vulnerable to monsoon storms and floods.
Magway	Rolling terrain; local steep sections	Some aggregates and gravel available	Dry zone; extended droughts
South Shan	Rolling to steep terrain. Width constraints in steep sections	Plentiful hard rock for aggregates, local shortages of natural gravel	Potential increased intensity of storms

AsCAP

Variations in Design Standards

Region	Key Standard Design Issues
Ayerawaddy	Embankment width constraints; possible passing places. Innovative use of local materials. Embankment climate protection. Possible use of low axle load structural design. Sealed pavements.
Magway	Sealing and increased drainage on steep sections. Increased structural pavement strength for numbers of commercial vehicles. Lack of water during construction – constraint on use of water-bound macadam.
South Shan	Width constraints in steep sections – modified geometry Increased drainage protection. Lack of natural gravel limits design options.

Flexibility is Key

The means of achieving "Fit of Purpose" may in terms of standards vary depending on the physical and engineering environment.

Ayerawaddy Issues

Standards
Narrow embankment
Canal one side

Specifications;
Potential soft foundations
Lack of stone for construction
Lighter traffic?

Road 45. Kyaiklat

Magway Issues

Standards
Poor horizontal/vertical alignments

Specifications;
Spot sealing
Heavy trucks?

AsCAP
As a Community Access Partnership

Shan Issues

Terrain

Steep, narrow alignments

Materials

Lack of natural gravel

Typical Range of Rural Road Classes

Class	Carriageway Width (m)	Shoulder Width (m)	Comment	Typical Design Vehicle
1	5.5	1.0-3.0	Shoulder width a function of pedestrian safety requirement.	Medium-large truck
2	3.5	1.0-1.5	Shoulder width a function of pedestrian safety requirement.	Small truck
3	3.0	0.5-1.0	Shoulder width a function of pedestrian safety requirement. Additional passing places possible if required.	Small truck
4	2.5	0.5-1.0	Shoulder width a function of pedestrian safety requirement. Additional passing places possible if required.	Pick-up
5	1.5	0	Motorcycle/bicycle/pedestrian only	Motor cycle

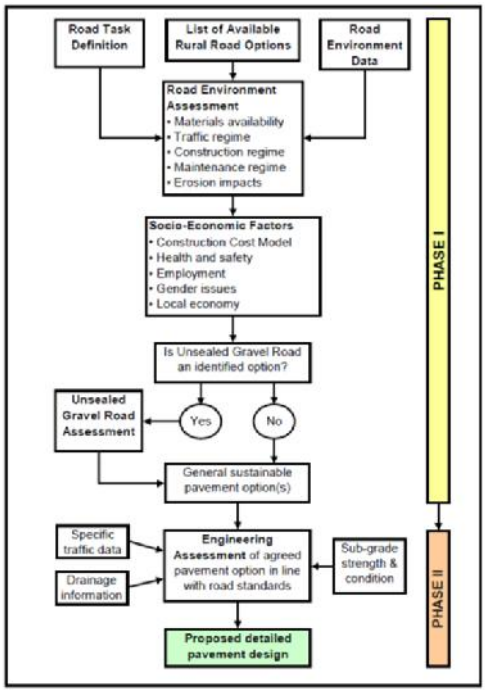
Pavement Options

Option	Comment
Gravel Wearing Course Sub-base	Sustainability issues in steep terrain (>6-8% gradient) with high rainfall
Thin wearing course over macadam base/sub-base	Current option in areas of plenty stone but limited gravel
DBST Base + Sub-base	Can be hot bitumen or bitumen emulsion (if available)
Concrete Sub-base	Non-reinforced concrete proven solution for rural roads
Penetration Macadam Base +Sub-base	Traditional solution. High bitumen content. Degradation issues if poor maintenance
Stone block/set over sub-base	Proven solution for smaller roads if locally available stone.
Brick/Block Sub-base	Proven solution if locally available block

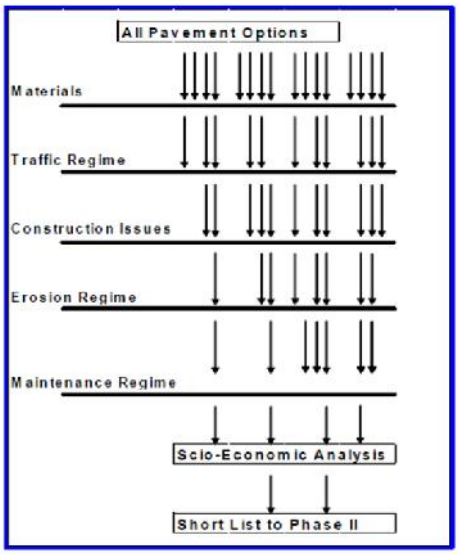
Materials Options for Pavement

A. Sub-Base	B. Base	C. Wearing Course	Surface
1. Natural gravel 2. Dry Bound Macadam (DBM) 3. Water Bound Macadam (WBM) 4. Graded Crushed Stone 5. Mechanical stabilisation 6. Chemical stabilisation local soil	1. Dry Bound Macadam (DBM) 2. Water Bound Macadam (WBM) 3. Graded Crushed Stone 4. Mechanical stabilisation 5. Chemical stabilisation local soil	1. Natural Gravel 2. DBM 3. WBM	1. DBST (Hot Bitumen) 2. DBST (Emulsion) 3. Penetration Macadam 4. Concrete (Non reinforced) 5. Concrete (Reinforced) 6. Block stone 7. Clay Brick 8. Concrete Brick

Typical Design Flow Chart



Filter Process



Flexible Standards

There needs to be some flexibility in standards and specifications within the physical environment of Myanmar that includes:

- Variable terrain: mountainous to deltaic terrain types.
- Variable climate impacts- from low lying flood to "Dry Zone"
- Variable vehicle and traffic patterns
- Variable materials availability
- Variable foundation (sub-grade) conditions

A basic framework can be adopted – but with appropriate variations. A.1, A.2, B.1 B.2 etc

DRD Research Supported by ReCAP

A review of existing rural road technical standards, specifications and design guidelines leading to recommendations on their upgrade and expansion within the current NRSSA classification framework.

It is intended that these revised standards and specifications will be available for adoption within parallel ADB, JICA, World Bank and KfW supported DRD programmes.

AsCAP
As a Community Access Partnership

Summary

The standards and the design process should take into account the NSRRA and the associated general classification, it is equally clear that in order to comply with current good practice there needs to be some flexibility in road standards for specific road environments.

The recommended “fit for purpose” approach implies that this flexibility will apply particularly to issues such as:

- Application of appropriate geometric standards
- Pavement options, both sealed and unsealed
- Use of available materials
- Current and future climate impacts

AsCAP Asia Community Access Partnership

Review of Rural Road Standards and Specifications in Myanmar

Definitions:

Road Design Standard = a minimum level of service that should be achieved at all times for the particular category of road. This translates in a set of agreed norms, uniformly applied in the design.

Standards are defined for different aspects of road design, such as:

- Geometric standards are intended to provide *minimum* levels of safety and comfort for drivers by provision of adequate sight distances, coefficients of friction and road space for manoeuvres. (from: *Low Volume Rural Road Surfacing and Pavement Guideline, OTB Engineering UK LLP 2013*). This includes minimum radii of horizontal and vertical curves, width or carriageway, shoulders and crossfall.
- Pavement standards provide minimum levels of service for the intended traffic (design vehicle); this includes comfort, speed, strength to withstand the total axle load over the life of the road.

AsCAP Asia Community Access Partnership

Review of Rural Road Standards and Specifications in Myanmar

Definitions:

- Drainage standards: the minimum capacity needed to drain water off and from the road; this refers to the drainage system = camber, side drainage, cross drainage structures, outlets, catchwater drains.
- Hydraulic standards: the minimum hydraulic capacity (opening) of structures channelling rivers and streams crossing the road, and minimum embankment heights to withstand high flood water levels.

Standards are 'legally' binding.

AsCAP Asia Community Access Partnership

Review of Rural Road Standards and Specifications in Myanmar

Definitions:

Technical Specifications = the norms, methods and features of a design (inputs) that lead to the desired standard. "How" it is achieved

- There can be more than one specification leading to the same result.
- Specifications may vary by road environment
- Specifications are drawn up in contracts to ensure uniformity and quality control of the works

Analogy:

Cooking book	= Design Manual / Design Guideline
Menu	= Design Standard
Recipe	= Design Specifications

AsCAP Asia Community Access Partnership

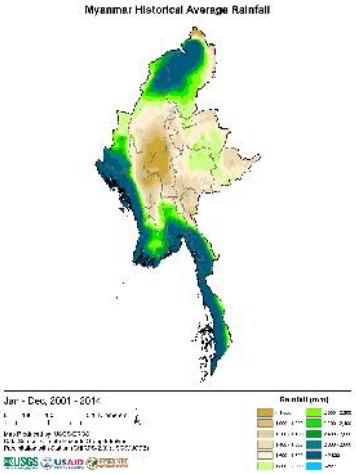
Review of Rural Road Standards and Specifications in Myanmar

High Volume Road Design	Low Volume Road Design
Traffic dominant in pavement deterioration	Environment (mainly moisture) dominant in pavement deterioration
Design reliability high (typically > 90%)	Design reliability modest (typically 50-90%)
Designed for higher speed (>80 km/h)	Designed for lower speed (< 40 - 60 km/h)
Main traffic composition: motorized vehicles	Main traffic composition: non-motorized vehicles
Focus on mobility function (speed)	Focus on access function (reliability)
Traditional thinking related to road design (what should be done)	Innovative and flexible thinking focusing on appropriate engineering judgment (what can be done with the resources available)
Designed by experienced International Consultants	Designed by Local Consultants and/or in-house by the Client with limited means
Implemented by experienced and well equipped international contractors	Implemented by local contractors using intermediate equipment and labour
Use of traditional materials (e.g. crushed stone, cement stabilized layers, hot mix asphalt, etc)	Use of non-traditional natural in gravels (e.g. pedogenic (in situ) materials), surfacing seals using cold mix asphalt, emulsion based seals, etc.

AsCAP
Asia Community Access Partnership

Review of Rural Road Standards and Specifications in Myanmar

Rainfall



- The "*wet zone*" in the southern coastal and delta area, including Ayeyarwady, Yangon, Bago, Tanintharyi regions, Rakhine and Mon States (26 % of the land).
- The "*dry zone*" of Central Myanmar, including Magwe, Mandalay and Sagaing regions (26 % of the land).
- The *intermediate* areas including, Kachin, Kayah, Kayin, Chin and Shan States (48 % of the land).

AsCAP
Asia Community Access Partnership

Review of Rural Road Standards and Specifications in Myanmar

Geology and Terrain

(i) **The northern mountains**; high annual average, high intensity rainfall. Sources of several great rivers, including the Irrawaddy and the Salween. The upper courses of these rivers all flow through deep gorges within a short distance of each other, separated by steep, sheer peaks.

(ii) **the western range region**, from the northern mountains to the southern tip of the Rakhine (Arakan) Peninsula. The mountains' average elevation is about 1,800 meters, although some peaks rise in height to 3,000 meters or higher. The whole western rage is characterised by high annual high intensity rainfall.

(iii) **the Shan Plateau**, in the eastern half of the country, is deeply dissected. Average elevation of about 900 meters. This is a a younger formation than the western mountains, with north-south longitudinal ranges rising steeply to elevations of 1,800 to 2,600 meters above the plateau surface.

(iv) **the Central basin and lowlands**, between the Rakhine mountains and the Shan Plateau, The basin was deeply eroded by the predecessors of the Irrawaddy, Chindwin, and Sittang rivers; Soft sandstones, shales, and clays with their alluvial deposits. In the delta regions formed by the Irrawaddy and Sittang rivers, the landscape is flat. The basin is divided into two unequal parts, the larger Irrawaddy valley and the smaller Sittang valley. Between these two valleys are the Bago Mountains

(v) **the Coastal area** consist of the narrow Rakhine and Tenasserim plains, which are backed by the higher ranges of the Rakhine and Tenasserim mountains. These coastal regions are fringed with numerous islands of varying sizes.

AsCAP
Asia Community Access Partnership

Review of Rural Road Standards and Specifications in Myanmar

Findings from field observations (1)

AsCAP
Asia Community Access Partnership

Review of Rural Road Standards and Specifications in Myanmar

Findings from field observations (2)

AsCAP
Asia Community Access Partnership

Review of Rural Road Standards and Specifications in Myanmar

Findings from field observations (3)



AsCAP
Asia Community Access Partnership

Review of Rural Road Standards and Specifications in Myanmar

Findings from field observations (4)

- The major part of the rural road network is unsealed and in a poor state, preventing all season access
- Many rural roads are in poor condition due to inadequate drainage systems and weak subgrades. .
- Existing alignments are often narrow (delta) or with sharp curves and limited space (Shan south)
- Uniform standards lead to problems in importing the 'right' materials for road construction; long distances, high costs, sparsity.
- Road environments across Myanmar are very diverse. Need to differentiate within the 3 rural road classes: design charts and technical specifications.

AsCAP
Asia Community Access Partnership

Review of Rural Road Standards and Specifications in Myanmar

Findings from field observations (5)

- Traffic is often an unknown factor and derived from estimates through interviews
- Demand from Districts for guidelines and training in survey and design and quality control
- Standard drawings and specifications development is working progress. Need for diversification taking account of terrain, climate, traffic, subgrade and road task
- KfW / RDP standards and specifications are developed from Cambodia and Laos with additions from SEACAP and other international best practice, but cater for the higher end rural roads.

AsCAP
Asia Community Access Partnership

Review of Rural Road Standards and Specifications in Myanmar

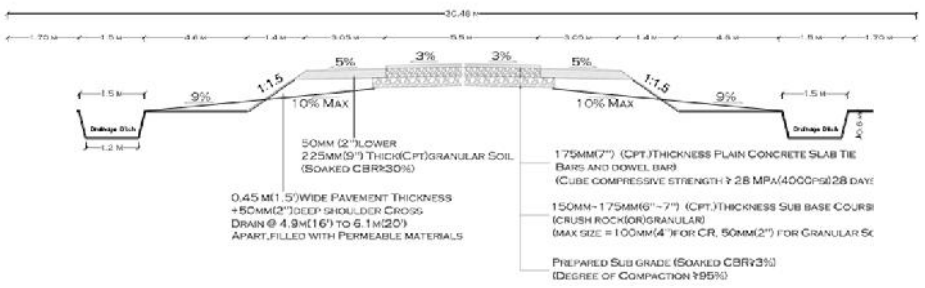
MOC Rural Road Standards

- From MOC (British) standards, adapted to suit rural roads. The standards are based on ORN 31.
- Uniform design standards and specifications for 3 classes of rural roads (A,B,C).
- Uniform lifespan cumulative standard equivalent axles in one direction assumed at 300,000
- Class A roads: standard for ADT<50 and 50<ADT<500. Design life respectively 12 and 18 years.
- Specifications for geometry, pavement layers and materials (ORN31) and AASHTO HS20-44 for bridges (36 t and 20 t)
- Three basic pavements: Macadam, Bituminous seal and Concrete. No GWC or Penmac

AsCAP
Asia Community Access Partnership

Review of Rural Road Standards and Specifications in Myanmar

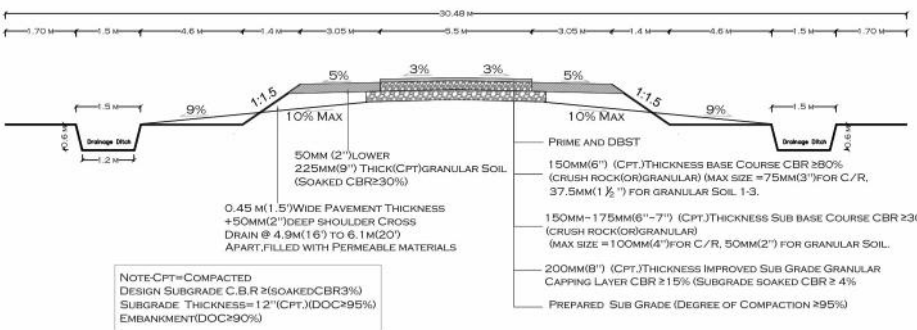
RURAL ROAD DESIGN STANDARD - CLASS (A) -CONCRETE ROAD



AsCAP
Asia Community Access Partnership

Review of Rural Road Standards and Specifications in Myanmar

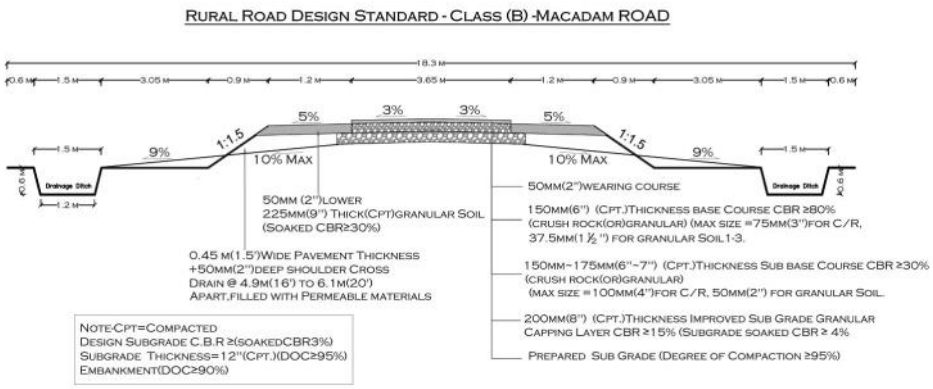
RURAL ROAD DESIGN STANDARD - CLASS (A) -BITUMINOUS ROAD



TYPICAL DESIGN CROSS SECTION OF RIGID PAVEMENT (RURAL ROAD)
(CUMULATIVE NUMBER OF STANDARD AXLES IN ONE DIRECTION <$0.3x10^6$)

AsCAP
Asia Community Access Partnership

Review of Rural Road Standards and Specifications in Myanmar



AsCAP
Asia Community Access Partnership

Review of Rural Road Standards and Specifications in Myanmar

Findings from review of existing standards

Existing standards / specifications:

3. The geometric standards by Rural Road Class are:

Rural Road Category	Traffic (ADT)	Carriageway width (m)	Shoulder width (m)	Total (m)
Class A	<50	3.65	3	9.65
Class A	50<ADT<500	5.5	3	11.5
Class B	-	3.65	1.2	6.05
Class C	-	-	-	-

4. The standard pavement options are:

Rural Road Category	Earth	Macadam	DBST	Concrete
Class A			✓	✓
Class B		✓	✓	✓
Class C	✓	✓		

AsCAP Asia Community Access Partnership

Review of Rural Road Standards and Specifications in Myanmar

Comparison of technical specifications

Class A *-comparison of technical specifications*

	DRRD	**RDP (Shan South)**	**Cambodia/Laos KfW-RIP**
Traffic Class	T1,T2	T1~T5	T1~T5
esa	0.3 x 10^6	up to 1 million	up to 1 million
ADT	<500		<2000
Axle load	not provided, but ORN31: 8.1t	8-10 t	4.5 t (LVRR), 4.5-10 t
Subgrade	S1, S2 (up to 4%CBR)	all subgrades	all subgrades
Carriageway width	5.5m (Class A) (3.5m for Class B, C)	4.5 m	2.5-5.5m
Type of pavement:	Macadam/DBST/CC	DBST/Penmac/CC	GWC/DBST/CC
Pavement layers	Boxed to carriageway width	full width	full width
Shoulder width	3m (Class A) (1.2m for Class B, C)	1 m	1 - 1.5m

AsCAP Asia Community Access Partnership

Review of Rural Road Standards and Specifications in Myanmar

Comparison of technical specifications

Embankment

Soaked CBR:	≥ 3% @ 95% AASHTO T180	≥ 6% @ 93% AASHTO T180	≥ 8% @ 93% AASHTO T180
Swell:	-	< 1.5%	target DN <27 mm/blow

Improved Subgrade

Soaked CBR:	≥3-4% @ 95% of AASHTO T 180	≥10% @ 95% of AASHTO T 180	≥11% @ 95% of AASHTO T 180
Swell:	-	< 1.5%	< 1.5%
Plasticity index:	<14%	< 18%	< 18%
Linear shrinkage	-	< 4%	< 4%
Max size:	-	75mm	100mm
Layer thickness	min 200 mm	max 300 mm	<50% layer thickness

AsCAP Asia Community Access Partnership

Review of Rural Road Standards and Specifications in Myanmar

Comparison of technical specifications

Capping Layer

Soaked CBR:	≥3-4% @ 95% of AASHTO T 180	≥12% @ 95% of AASHTO T 180	≥11% @ 95% of AASHTO T 180
		(target DN 18mm/blow)	(target DN 18mm/blow)

Subbase **(grading curves not included in this comparison)**

Materials	Crushed rock or granular	crushed aggregate	Crushed rock or granular
IP	-	<11%	<12%
LAA	-	<40 (AASHTO T-96)	<40 (AASHTO T-96)
CBR	≥ 30% @ 95% AASHTO T180	≥ 30% @ 95% AASHTO T180	≥ 25% @95% AASHTO T-180
		(target DN 8mm/blow)	≥ 30% @ 95% AASHTO, for axle load>5t and esa >100,000
Swell:	-	<1%	< 1 %

AsCAP Asia Community Access Partnership

Review of Rural Road Standards and Specifications in Myanmar

Comparison of technical specifications

Base **(Sieve curves not included in this comparison)**

Materials	Crushed rock or granular	Water bound Macadam	Aggregate, crushed rock
CBR	≥ 80% @ 95% AASHTO T180	LAA <35 (AASHTO T-96)	≥ 80% @ 95% AASHTO T180
		Sodium Sulphate <25%	Aggr> 2.0 mm: Los Angeles: ≤ 35% AASHTO T 96
		max 50% of layer thickness	fraction< 0.425mm: PI <12%
max size of aggregates:	75mm for crushed rock	specific grading curve provided	specific grading curve provided
	37.5mm for granular		

AsCAP Asia Community Access Partnership

Review of Rural Road Standards and Specifications in Myanmar

Findings from review of existing standards

1. Traffic volume is uniformly assumed to be 300,000 esa, while subgrade strength is assumed weak (up to CBR 4%). This may lead to overdesign of the pavement layers in stronger subgrades and with lower traffic volumes and possibly to under-design of roads with higher traffic volumes. A design chart could be developed
2. The standards include bitumen and concrete surface options for Class A roads.
3. There may be arguments to include macadam surfaced roads where the traffic volumes are low. Horizontal and vertical curves, at design speeds, taking account of road safety sightlines, stopping distance, turning circles of vehicles, widening of curves, transition curves, superelevation.
4. Full width pavement layers (as practiced under KfW-RDP), to reduce risk of water logging and unequal consolidation

AsCAP Asia Community Access Partnership

Review of Rural Road Standards and Specifications in Myanmar

Findings from review of existing standards

1. Standard

AsCAP Asia Community Access Partnership

Review of Rural Road Standards and Specifications in Myanmar

Group work questions on findings

Group split by zones (dry, delta, mountain):

1. Do you agree with the finding of the study that the existing road design standards and specifications in Myanmar require differentiation for different road environments and road tasks? Please elaborate.

2. The geometric and pavement design standards currently under preparation for DRRD consider a maximum traffic of 500 vehicles per day (geometric design) and a maximum of 0.3 MESA (pavement design) over the road design life? Are these thresholds considered appropriate? Please elaborate.

3. Should there be more options for pavement design? Which?

4. Name at least three main issues of LVRR design in Myanmar that should be addressed by a LVRR manual? Please elaborate.

AsCAP Asia Community Access Partnership

Review of Rural Road Standards and Specifications in Myanmar

Session 4: Development of Standards for LVRR

1. Defining LVRR in the Myanmar context: cat A, B, C
2. Reference manuals vs existing standard: Comparison of three selected manuals
3. Boundaries of what a manual should cover

AsCAP
Asia Community Access Partnership

Review of Rural Road Standards and Specifications in Myanmar

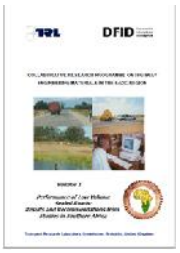
Comparison of the development of LVR Manuals in Africa and the SEA Region

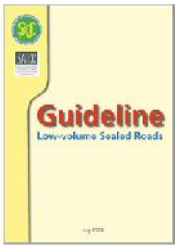
AsCAP
Asia Community Access Partnership

Review of Rural Road Standards and Specifications in Myanmar

History of LVR manual development

- LVR manual development in Africa followed 3 decades of research– mainly Southern Africa – and monitoring Long Term Pavement Performance (LTPP)
- Landmark DFID funded research project implemented by TRL: *"Collaborative research programme on highway engineering materials in the SADC region, Results and Recommendations from Studies in Southern Africa (1999)"*
- Led to development of regional guidelines for SADC/SATCC member countries: *"Guidelines for Low Volume Sealed Roads (2003)"*
- In recognition of the wide variety in natural, physical, economical and social environments and the need to embed LVR design in national standards and specifications this led to the development of country specific manuals - mainly supported by AFCAP (now under RECAP umbrella)
- Overview Africa: Ethiopia (draft 2011, final 2016); Malawi (2013); South Sudan (2013); Tanzania (2016); Kenya (2017); Mozambique (2017); Zambia, Liberia, Ghana and Sierra Leone (in progress)
- In Asia, the development of manuals is not as far progressed as in Asia. Seacap has financed research in improving standards and specifications, especially on pavement design and subgrade strengthening. ILO and other organisations have supported such research too, especially in trials of meachnical and chemical stabilisation and different pavement options. Overview Asia: Laos (2008), Cambodia (2007/09): improvement of design tools, Bangladesh (2017?), Nepal (2012), ..
- Looked more closely at three different scenarios: Tanzania (broad scenario, paved and unpaved roads), Malawi (narrow scenario, upgrading to paved standard), Laos (narrow spectrum and specifically for LVR with ADT <150)



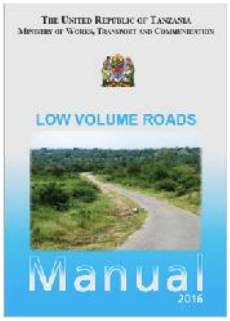


AsCAP
Asia Community Access Partnership

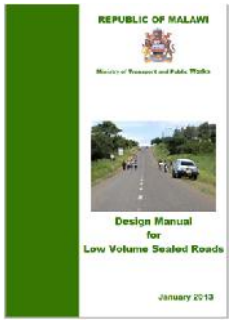
Review of Rural Road Standards and Specifications in Myanmar

Comparison table

LVR Manual Tanzania



LVR Manual Malawi



LVR Manual Laos

AsCAP
Asia Community Access Partnership

Review of Rural Road Standards and Specifications in Myanmar

Comparison general

Tanzania

- Low Volume Roads Manual
- 500 pages
- Took 3 years
- 5 experts, ±12 p/m, >£200k
- LVR: < 300 vpd,
- < 1 MESA
- Moderate coverage
  - Design of paved and unpaved roads, flexible, rigid and discrete elements
  - Planning, investigation, design and construction elements

Overseen by a TWG from private and public sector

Malawi:

- Design Manual for Low Volume Sealed Roads
- 200 pages
- Took < 2 years
- 1 expert, < 6 p/m, < 100k
- LVR: < 300 vpd, < 1 MESA
- Narrow coverage:
  - Main focus on design for upgrading of unpaved roads to sealed standard (DBST)
- Overseen by a TWG from private and public sector

Laos:

- Design Manual for Low Volume Roads
- 138 pages for manual and 117 for EOD manual
- Took 2 Years
- Unknown resource input
- LVR: < 150 vpd, < 0.1 MESA
- Narrow coverage:
  - Main focus on design for upgrading of unpaved roads to appropriate standard with different pavements

AsCAP Asia Community Access Partnership

Review of Rural Road Standards and Specifications in Myanmar

Comparison geometric design

Tanzania

AADT	Carriageway	Shoulder
200 - 400	6.5m	Varies
50 - 200	6.5m	Varies
20 - 50	5.5m	Varies
< 20	4.0m	Varies

- Modification of the basic geometric standards required for road safety reason, in areas with a high incidence of motor cycles, bicycles and pedestrians (measured as PCUs)
- Paid substantial attention to road safety measures

Malawi:

AADT	Carriageway	Shoulder
150 – 300	6 - 6.5m	1.25m
75 – 150	5.5 - 6.5m	1.0m
< 75	3 m	1.5m

- Main focus on upgrading of existing roads. No other geometric design standards provides (curve radius etc.)
- Paid substantial attention to road safety measures

Laos:

AADT (<150)	Carriageway	Shoulder
<0.01 mesa	2.5 m	1 m
<0.1 mesa	3.5 m	1 m
>150 AADT	2.5 - 3.5m	1.5 m

- Main focus on upgrading of existing roads and provision of access of LVR with AADT below 150 and below 100,000 esa.
- Over 0.1 mesa and traffic in higher category: MPWT standards (up to 2000 AADT); based on ORN31

AsCAP Asia Community Access Partnership

Review of Rural Road Standards and Specifications in Myanmar

Comparison pavement design

Tanzania

- LVR: < 300 vpd, < 1 MESA
- Design method: DCP-DN and DCP-CBR
- Pavement design catalogue

Malawi

- LVR: < 300 vpd, < 1 MESA
- Design method: mainly DCP-DN
- Pavement design catalogue

Laos

- LVR: < 150 vpd, < 0.1 MESA
- Design method: mainly CBR and DCP-CBR
- Pavement design catalogue

AsCAP Asia Community Access Partnership

Review of Rural Road Standards and Specifications in Myanmar

Table 13-1: Comparison of DCP-DN and DCP-CBR methods

Property	DCP-DN method	DCP-CBR method
Samples	Random subgrade samples for moisture content (MC) and compaction testing.	Regular samples for MC and compaction testing. Samples from 3 layers to 450 mm depth.
Strength	Use DCP to assess in situ conditions. Use DCP penetration rate (DN) directly (in situ strength). No modifications required.	Use DCP to assess in situ conditions. Requires conversion of DN to CBR. CBR converted to soaked values. Soaked CBR converted to layer strength coefficients for SN.
Uniform sections	CUSUM based on actual DN and DSN800 values of each point.	CUSUM based on SN deficiency of each individual point or based on any of the parameters obtained from the DCP test.
Layers	150 mm layers with weighted average strength analysed.	Variable layer thicknesses with average strength. Analyses for multiple layers (bases, subbases and subgrade(s).
Design	Uses in situ strength and variable strength for base. Variable percentile used depending on in situ moisture regime and traffic. In-service moisture regime estimated from visual survey.	Requires minimum soaked CBR of 45% for base. For strengthening an existing road the 90th, 75th or 50th percentile of the additional SN required is used, depending on traffic.

AsCAP Asia Community Access Partnership

Review of Rural Road Standards and Specifications in Myanmar

Comparison materials

Tanzania

- Natural gravels:
  - The strength and plasticity specs depend on the traffic level and subgrade class
  - Max. PI 6% for higher traffic classes on weaker subgrades increased
  - Max PI 15% for low traffic class and strong subgrades.
- Laterites (pedogenic materials):
  - Max. PI of 9% for higher traffic and weaker subgrades (S2)
  - Max PI of 25% for lower traffic and stronger subgrades

Malawi:

- The manual refers to materials specifications to exclude unsatisfactory materials for use in roads by placing limits on their various properties such as grading, plasticity and strength.
- However, no specific guidance provided on materials parameters, e.g.
  - Grading
  - PI
- Material's physical properties are related to performance in a particular environment. Key materials parameters for pavement layers are :
  - Strength (DN value)
  - Strength/moisture/density relationship

Laos:

- The manual refers mainly to traffic and subgrade (CBR) strength to come to pavement design to material;
- The Part II of the manual provides technical specifications mainly referring to AASHTO.

AsCAP Asia Community Access Partnership

Review of Rural Road Standards and Specifications in Myanmar

Comparison drainage design

Tanzania

- Indicative return periods given by type of structure and road class
- Hydrological analysis:
  - Direct observation
  - Replicating successful practice
  - The Rational Method
- Hydraulic design: use of nomogram
- Standard drawings: not included, but indicative solutions and a decision chart of selecting the best type of structure

Malawi:

- Main focus on side drains, in particular crown height
- Return period for different structures: reference to national standards Hydrological analysis: not included
- Hydraulic design methods: not included
- Standards drawings for structures: not included

Laos:

AsCAP Asia Community Access Partnership

Review of Rural Road Standards and Specifications in Myanmar

Key findings

- LVR threshold (< 150-300 AADT and < 1 MESA)
- Variety in development LVR manuals:
  - Country specific needs
  - Availability and quality of existing manuals
  - Local experience with LVR research (e.g. trials, back analysis)
- Main focus:
  - Pavement design using DCP-method
  - Selection of appropriate materials for imported pavement layers and use of in situ materials
  - Road surfacing options
- Other topics (e.g. survey, geometry, drainage, maintenance, construction and technical specifications and drawings) given secondary importance
- Pavement design catalogue: based on traffic, subgrade and climate and terrain
- Some reluctance to abolish the 'conventional' CBR based design method (e.g. Tanzania included the DCP-CBR design method)
- Missed opportunities: climate change adaptation and resilience building, hydraulic and hydrological design
- Some attention to road safety but room for improvements in particular in view of rapid changes in traffic composition (e.g. use of motorcycles)

AsCAP Asia Community Access Partnership

Review of Rural Road Standards and Specifications in Myanmar

Group work topics

Group 1	Group 2	Group 3
Geometric Design Standards	Drainage / Hydraulic Design Standards	Pavement Design Standards

AsCAP Asia Community Access Partnership

Review of Rural Road Standards and Specifications in Myanmar

Working Group 1 Questions: (Geometric Design Standards)

1. In view of what is needed for your work as rural road design engineer, what subjects should be included in a Low Volume Rural Road Design Manual related to geometric design? Please elaborate
2. Is the network tier (level in the hierarchy) sufficient to set the geometric design standard? (Category 1, 2 and 3 rural roads), or should there be a differentiation by terrain type, soil condition (road environment), road task / traffic? Any other considerations?
3. In addition to the geometric standards, should the manual include a wider scope? Such as:
   - Road safety standards/ traffic calming standards
   - Planning and functional classification?
   - Field investigations and surveys?
   - Quantification and costing?
   - Maintenance?
   - Other?

AsCAP Asia Community Access Partnership

Review of Rural Road Standards and Specifications in Myanmar

Working Group 2 questions: (Drainage and Hydraulic design standards:

1. In view of what is needed for your work as rural road design engineer, what subjects should be included in a Low Volume Rural Road Design Manual related to hydrological analysis and hydraulic design? Please elaborate
2. Provide feedback on the following subjects; should it be included and should it vary by road category?
   - How should climate change impact be accommodated in the manual?
   - Catchment assessments?
   - Hydraulic design of side drains and structures?
   - Hydraulic design of cross drainage (bridges, larger culverts, drifts, etc)
   - Construction standards for structures?
   - Other?

AsCAP Asia Community Access Partnership

Review of Rural Road Standards and Specifications in Myanmar

Working Group 3 questions: (pavement design standards)

1. In view of what is needed for your work as rural road design engineer, what subjects should be included in a Low Volume Rural Road Design Manual related to design? Please elaborate
2. Should there be standard pavement types for the three rural road categories, or should there be differentiation in pavement even within the three categories?
3. What pavement types could you think of? Which should be included in the LVRR manual?
4. What factors would influence the choice of pavement? How do these play a role in the different terrain and climatic environments in Myanmar

AsCAP Asia Community Access Partnership

Review of Rural Road Standards and Specifications in Myanmar

Session 6: The Way Forward

Outline for Phase 2 - Development of a LVRR Manual

AsCAP Asia Community Access Partnership

Review of Rural Road Standards and Specifications in Myanmar

Implementation strategy

- Perspective:
  - LVR manual development in Africa followed decades of research projects, long term pavement monitoring and capacity building of road sector institutions
  - Myanmar has had limited exposure to international experience in LVR research
- The rationale of LVR manual development: develop home grown standards on the basis of local context
- On what basis would a LVR manual in Myanmar be developed?
  - Regional experience (SEACAP)?
  - African experience (AFCAP)?
  - The few projects being implemented (ADB, KFW and WB) that have imported standards from other countries?
- Two scenarios considered:
  - 1. Staged development: prepare **LVR Guidelines** and make use of ongoing projects in Myanmar to promote and guide LVR research which in the medium term (5-10 years) could be developed into a **Manual**
  - 2. Leapfrog: prepare a LVR **Manual** on the basis of regional and/or international experiences

AsCAP Asia Community Access Partnership

Review of Rural Road Standards and Specifications in Myanmar

Scenario 1: Staged development

Advantages:

- Relatively easier to prepare and adopt
- Encourages further research and innovation
- Allows more time to consider the full extent and variety of Myanmar's environment including possible climate change effects
- Allows more time to fully understand the Myanmar's economic development and the impact on road transport

Disadvantages:

- May result in some inconsistency and variation of applied standards in the short to medium term
- May be subject to higher level of resistance (e.g. engineering conservatism) leading to continued use of excessive standards for LVR
- Once guidelines are in place, the momentum for development of a LVR manual may be lost

AsCAP Asia Community Access Partnership

Review of Rural Road Standards and Specifications in Myanmar

Scenario 2: Leap frogging

Advantages:

- Consistency in applied standards and reduced deviation from the agreed LVR standards
- Although subject to high level of resistance (e.g. engineering conservatism) initially, once adopted this will reduce the use of excessive standards for LVR
- Takes benefit of the momentum where many development partners are willing to support the LVR sector in Myanmar

Disadvantages:

- More expensive and takes much longer to prepare than guidelines
- Will limit incentives for further research and innovation in LVR
- Does not allow sufficient time to understand full extent and variety of Myanmar's environment including possible climate change effects
- Does not allow sufficient time to fully understand Myanmar's economic development and the impact on the road transport sector

AsCAP Asia Community Access Partnership

Review of Rural Road Standards and Specifications in Myanmar

Recommendation

- Following the findings from this review, in particular:
  - The absence of any road standards and specifications
  - The limited exposure and experience to LVR (research) projects
- The Consultant recommends: a staged development process initially focusing on LVR guidelines while allowing more home grown experiences to be gained in LVR research

AsCAP Asia Community Access Partnership

Review of Rural Road Standards and Specifications in Myanmar

Project Management

- Creation of a Technical Working Group (TWG) with representatives from:
  - Public sector (examples …)
  - Professional bodies (…)
  - Private sector (…)
- TWG prepares (possibly supported by an individual consultant):
  - A concept paper for the development of LVR in Myanmar
  - Proposal for the establishment of a road research centre to oversee LVR research
  - A framework for setting up LVR research trials, including M&E, as part of ongoing projects
  - Based on this review, a TOR for Phase 2 “Development of LVR Guidelines”
- TWG discuss project proposals with AsCAP PMU
- AsCAP: recruitment of an International Consultancy Firm experienced in the development of LVR guidelines and manuals
- Project management by PMU and TWG

AsCAP Asia Community Access Partnership

Review of Rural Road Standards and Specifications in Myanmar

Action Plan

- Action plan milestones
  - A concept paper with a proposal for the establishment of a LVR research centre (April 2018)
  - A framework for setting up LVR research trials, including M&E, as part of ongoing projects (May 2018)
  - Final TOR, Action Plan and Budget for Phase 2 "Development of LVR Guidelines" (Jun 2018)
  - Procurement of the Consultancy Firm (Jul – Sep 2018)
  - LVR Guidelines development (Oct 2018 – Jun 2020)

AsCAP Asia Community Access Partnership

Review of Rural Road Standards and Specifications in Myanmar

Workshop Evaluation and Closure

- Rap-up and Evaluation
- Closing Remarks


AsCAP
Asia Community Access Partnership
Review of Rural Road Standards and Specifications in Myanmar
UKaid
from the British people
Thank you for your attention
www.research4cap.org

Insert pdf of Power Point presentation

Annex 3: Comparison of LVRR Manuals

Tanzania (moderate spectrum)

General	
Title	**Low Volume Roads Manual**
Host institution	Ministry of Works, Transport and Communications (MOWTC)
Funding	AfCAP-1
Management of the Project	AfCAP PMU. The development of the manual was guided by a Roads Technical Committee and a Technical Working Group comprising professionals from both public and private sector organizations in Tanzania.
Members of the TWG	MOWTC National Road Agency RFB Local Government Consultants
Year published	2016
Year started	2013
Time taken	3 years
Resources used	
Budget (GBP)	202,470
Number of experts	5
Expert staff months (est.)	12
Comment	Full development
Definition of LVR	Low volume roads (LVRs), defined as those roads which, over their design life, are required to carry an average of about **300 motor vehicles per day, and less than about 1.0 million equivalent standard axles** (MESA) in one direction, comprise a substantial proportion of the road network in Tanzania (> 75%).
Objective	The main purpose of this Manual is to provide practitioners with the requisite tools for undertaking a holistic, rational and affordable approach to the provision of LVRs in Tanzania. Such an approach is aimed at minimising the life-cycle costs of road provision by taking account of the many locally prevailing road environment factors that impact on the performance of LVRs.
Rationale	The Manual draws on the outputs of a number of research and investigation projects that have been carried out in the region since the 1990s. The corroborative findings of these projects provide a wealth of performance and evidence based information that has advanced previous knowledge on various aspects of LVR technology. This has allowed state-of-the-art guidance to be provided in the Manual which is expected to serve as a nationally recognized document, the application of which will harmonize approaches to the provision of LVRs in Tanzania. The Manual is intended for use by road authorities at central and local government level, as well as by private sector consultants.

Number of pages	505
Structure	1 document, A4 size
Table of Contents / Modules	

Table 1-1: Structure and content of manual

Part	Chapter
A. Introduction	1. General Introduction 2. Low Volume Roads in Perspective 3. Physical Environment
B. Planning	4. Rural Accessibility Planning
C. Investigations	5. Site Investigations 6. Geotechnical Investigations and Design 7. Construction Materials 8. Traffic
D. Design	9. Geometric Design 10. Road Safety 11. Hydrology and Drainage Structures 12. Drainage and Erosion Control 13. Structural Design: Paved Roads 14. Structural Design: Unpaved Roads 15. Surfacing 16. Life-Cycle Costing
E. Construction	17. Construction, Quality Assurance and Control 18. Borrow Pit Management 19. Technical Auditing

Technical content	
Road design life	Typical 15 years
Geometric Design	
Overview	

Table 9-1: Recommended basic geometric standards

Road Class	Design Traffic Flow (AADT) (Mid-life)	Surface Type	Right of way (m)	Width (m)	
				Carriageway	Shoulder
DC5 (2)	200 – 400	Paved Unpaved	60	6.50	Varying(1)
DC6	50 – 200	Paved Unpaved	40	6.00	Varying(1)
DC7	20 – 50	Paved(3) Unpaved	30	5.50	Varying(1)
DC8	< 20	Paved(3) Unpaved	20	4.00	n/a

(1) Normal width 1.0 m where required and feasible, but width varying with terrain. See 9.4.2.
(2) DC5 roads with < 400vpd and not likely to change to a higher functional classification within the design period.
(3) On steep sections.

Pavement Design	
Method	DCP-DN and DCP-CBR methods.
ESA	The equivalent standard axle imposes a load of 8,160 Kg.

Design Catalogue

Table 13-6: Bituminous pavement design Chart 2 (moderate and dry areas)

Subgrade CBR	TLC 0.01	TLC 0.1	TLC 0.3	TLC 0.5	TLC 1.0
	< 0.01	0.01-0.1	0.1-0.3	0.3-0.5	0.5-1.0
S1 (<3%)	Special subgrade treatment required				
S2 (3-4%)	150 G45 150 G15	150 G65 125 G30 150 G15	150 G80 150 G30 175 G15	175 G80 150 G30 175 G15	200 G80 175 G30 175 G15
S3 (5-7%)	125 G45 125 G15	150 G55 175 G30	175 G65 175 G30	175 G80 200 G30	175 G80 250 G30
S4 (8-14%)	200 G45	150 G55 100 G30	150 G55 150 G30	175 G65 150 G30	175 G80 175 G30
S5 (15-29%)	150 G45	200 G55	125 G55 125 G30	125 G65 125 G30	150 G80 125 G30
S6 (>30%)	150 G45	175 G45	175 G55	175 G65	175 G80

G45 is a layer with CBR 45%, etc.

Drainage Design	The manual includes drainage design (look up tables), hydrology (rational method and direct observation) and hydraulic design (Manning and Charts).
Cross cutting issues	
Road safety	Included
Climate change	Not covered
Standard Drawings included?	Not included
Specifications included?	Not included

Malawi (narrow spectrum)

General	
Title	**Design Manual for Low Volume Sealed Roads**
Host institution	Ministry of Transport and Public Works (MTPW)
Funding	AFCAP-1
Management of the Project	AfCAP PMU. The development of the manual was guided by a Technical Working Group comprising professionals from both public and private sector organizations in Malawi.
Members of the TWG	Ministry of Transport. Roads Authority. Road Fund Administration. National Construction Industry Council (NCIC). University of Malawi. Consultants. Contractors. Road Materials Suppliers.
Year published	2013
Year started	2012
Time taken	1.5 years
Resources used	1 document, A4 size
Budget (GBP)	Not known
Number of experts	1 document, A4 size
Expert staff months (est.)	Not known
Comment	
Definition of LVR	Low volume roads (LVRs), defined as those roads that carry both less than about **300 vehicles per day** (vpd) and less than about 1 million equivalent standard axles over heir design life.
Objective	The Manual applies only to the upgrading of existing unsealed LVRs to a sealed standard using the existing alignment to the maximum extent possible. The design of such upgrading is based on the Dynamic Cone Penetrometer (DCP) and is aimed at achieving a balanced pavement design whilst optimizing the in situ material strength in the existing gravel road.
Rationale	Whilst there are significant life-cycle benefits to be achieved from upgrading Malawi's relatively lightly trafficked unpaved roads to a paved standard, the cost of doing so following traditional standards and specifications is prohibitive. However, based on research and investigations carried out over many decades in the Southern African region, including Malawi, there is now performance-based evidence on which new design standards and specifications for various aspects of low volume sealed road provision can be based. These findings have been incorporated in the development of this Design Manual for Low Volume Sealed Roads in which the design of the pavement is based specifically on the Dynamic Cone Penetrometer (DCP) design method. The manual reflects historical experience in Malawi and the region and takes full account of the positive experience gained in the country from the construction of similar roads dating back over 20 years.

Number of pages	185
Structure	1 document, A4 size
Table of Contents / Modules	**Section A**: Overview: 1. Introduction 2. Main components of a LVSR **Section B**: Road design process 1. Design process 2. Preliminary road evaluation 3. Traffic4. Geometrics and road safety 5. Pavement design 6. Materials 7. Surfacings 8. Drainage **Section C:** Design philosophy and guidelines 1. Design considerations 2. Environment 3. Materials 4. Pavement design 5. Practical considerations 6. Cost analysis 7. Implementation
Technical content	
Road design life	Typical 15 - 20 years
Geometric Design	
Overview	**Table 4-1: Typically recommended roadway widths** Traffic flow (AADT) / Roadway width (m): Carriageway / Shoulder / Total 150-300: 6.0 – 6.5 / 2 x 1.25 / 8.5 – 9.0 75-150: 5.5 – 6.0 / 2 x 1.0 / 7.5 – 8.0 < 75: 3.0 – 3.3* / 2 x 1.5 / 6.0 – 6.3 * essentially a single lane road with wide shoulders
Pavement Design	
Method	DCP-DN method. The design of such upgrading is based on the Dynamic Cone Penetrometer (DCP) and is aimed at achieving a balanced pavement design whilst optimizing the in situ material strength in the existing gravel road.
ESA	The equivalent standard axle imposes a load of 8,200 Kg.
Design Catalogue	**Table 5-1: DCP design catalogue for different traffic classes**

Traffic Class E80 x 10^6	LE 0.01 0.003 – 0.010	LE 0.03 0.010 – 0.030	LE 0.1 0.030 – 0.100	LE 0.3 0.100 – 0.300	LE 0.7 0.300 – 0.700	LE 1.0 0.700 – 1.0
0- 150mm Base ≥ 98% MAASHTO	DN ≤ 8	DN ≤ 5.9	DN ≤ 4	DN ≤ 3.2	DN ≤ 2.6	DN ≤ 2.5
150-300 mm Subbase ≥ 95% MAASHTO	DN ≤ 19	DN ≤ 14	DN ≤ 9	DN ≤ 6	DN ≤ 4.6	DN ≤ 4.0
300-450 mm subgrade ≥ 95% MAASHTO	DN ≤ 33	DN ≤ 25	DN ≤ 19	DN ≤ 12	DN ≤ 8	DN ≤ 6
450-600 mm In situ material	DN ≤ 40	DN ≤ 33	DN ≤ 25	DN ≤ 19	DN ≤ 14	DN ≤ 13
600-800 mm In situ material	DN ≤ 50	DN ≤ 40	DN ≤ 39	DN ≤ 25	DN ≤ 24	DN ≤ 23
DN 800	≤ 39	≤ 52	≤ 73	≤ 100	≤ 128	≤ 143

Drainage Design	The Manual provides a framework to assist the designer in evaluating the adequacy of existing drainage infrastructure and the need for new infrastructure. However, the manual does not deal with detailed drainage design, hydrology and hydraulic design, which can be found in other guidelines.

Cross cutting issues	
Road safety	Included
Climate change	Not covered
Standard Drawings included?	Not included
Specifications included?	Not included

Laos (narrow spectrum)

General	
Title	**Low Volume Rural Road Standards and Specifications**
Host institution	Ministry of Public Works and Transport (MPWT)
Funding	SEACAP-3
Management of the Project	SEACAP PMU
Members of the TWG	Ministry of Public Works and Transport (MPWT) TRL
Year published	Not officially published. Draft in 2008/2009 (EOD manual)
Year started	2007?
Time taken	2 years?
Resources used	3 main parts and an EOD manual
Budget (GBP)	Not known
Number of experts	4 documents, A4
Expert staff months (est.)	Not known
Comment	narrow spectrum
Definition of LVR	Low Volume roads divided into two traffic classes: Traffic **Group A**: An AADT of all 4-wheeled vehicles of **< 150**, and a cumulative traffic loading of **< 10,000 esa's**; Traffic **Group B**: an AADT of all 4-wheeled vehicles of <150, and a cumulative traffic loading of 10,000< esa< 100,000; All traffic design axle loading of **less than 4.5T** Above the threshold reference is made to ORN31 and interim MPWT standards (up to AADT of 2000)
Objective	The manual is restricted to LVRs, designed for traffic volumes below AADT 150 and esa lower than 100,000 and a standard axle load of 4.5 t. Beyond this the manual refers to the MPWT standard designs for roads up to 2000 AADT, based mainly on ORN31.
Rationale	The rationale for this manual is to provide the design engineers with options for the lower categories rural roads. The manual provides guidance on the pavement design for improved access with GWC, bituminous seal and unreinforced concrete. Selection of the type of pavement is not discussed in detail: considered are availability of natural gravels, steepness, dust hazard and subgrade strength.
Number of pages	138 (3 parts) and 117 for EOD
Structure	Manual in 3 parts (volumes) and a separate EOD manual, all A4 size
Table of Contents / Modules	Part I - Classification and Geometric Standards:containing the definition of the traffic limits to Lao LVRRs and the related geometricstandards: -LVRR Classification, - Geometric design, - Drainage Part II - Pavement Options and Technical Specification:containing technical specifications for an initial short list of pavement and surfacing options and a matrix of standard designs based on these options.1. Pavement: -LVRR Pavement and Surfacing Options, - types and thickness, -surfacing matrix 2. Key Technical Issues: -Surfacing materials, -Gravel wearing course, -Sealed

<table>
<tr><td></td><td>surfacings, -Concrete surfacing 3. Pavement construction materials: -Roadbase, -Sub-base, -Capping layer, -Shoulders4 Drainage: -Pavement cross-section, -Drainage of layers, -Shoulder drainage, -External drainage Part III: Guidelines on the Application of LVRR Standards and Specifications:containing advice on the application of Parts I and II within an Environmentally Optimised Design strategy ranging from Spot Improvement to the construction or upgrade of whole road links.1. LVRR Principles: -Environmentally Optimised Design, -Pavement options, -Pavement design life, -Traffic, -Outline Pavement Selection and Design Process 2. Phase I-General Assessment of Pavement Options3. Phase II-LVRR pavement and surfacing option design4. Road drainage 5. Structures6. Construction: -Construction procedures, -Supervision and quality control, -Quality assessment 7. Environmental Impact Considerations</td></tr>
<tr><td>Technical content</td><td></td></tr>
<tr><td>Road design life</td><td>Typical 10-15 years</td></tr>
<tr><td>Geometric Design</td><td></td></tr>
<tr><td>Overview</td><td>
<table>
<tr><th rowspan="2">Final Year AADT of Category 4 Traffic</th><th colspan="2">Final year AADT of Category 1 Traffic</th></tr>
<tr><th>< 150</th><th>≥ 150</th></tr>
<tr><td>None</td><td>Carriageway width = 2.5 m
Shoulder width = 1 m</td><td>Carriageway width = 2.5 m
Shoulder width = 1.5 m</td></tr>
<tr><td>Some</td><td>Carriageway width = 3.5 m
Shoulder width = 1 m</td><td>Carriageway width = 3.5 m
Shoulder width = 1 m</td></tr>
</table>
</td></tr>
<tr><td>Method</td><td>DCP-CBR method.</td></tr>
<tr><td>ESA</td><td>The equivalent axle imposes a load of 8,200 kg</td></tr>
<tr><td>Design Catalogue</td><td>Table A4:
<table>
<tr><th colspan="3">Traffic Group A (10,000 esa)</th><th colspan="3">Traffic Group B (<100,000 esa)</th></tr>
<tr><th>Subgrade Soaked CBR%</th><th>Pavement Layer</th><th>Layer Thickness D (mm)</th><th>Subgrade Soaked CBR%</th><th>Pavement Layer</th><th>Layer Thickness D (mm)</th></tr>
<tr><td rowspan="2">2 - 4</td><td>Wearing Course</td><td>200</td><td rowspan="2">2 - 4</td><td>Wearing Course</td><td>200</td></tr>
<tr><td>Capping Layer</td><td>250</td><td>Capping Layer</td><td>300</td></tr>
<tr><td rowspan="2">4 - 7</td><td>Wearing Course</td><td>200</td><td rowspan="2">4 - 6</td><td>Wearing Course</td><td>200</td></tr>
<tr><td>Capping Layer</td><td>100</td><td>Capping Layer</td><td>150</td></tr>
<tr><td rowspan="2">>7</td><td>Wearing Course</td><td>200</td><td rowspan="2">6 - 8</td><td>Wearing Course</td><td>200</td></tr>
<tr><td>Capping Layer</td><td>-</td><td>Capping Layer</td><td>100</td></tr>
<tr><td colspan="3" rowspan="2"></td><td>>8</td><td>Wearing Course</td><td>200</td></tr>
<tr><td></td><td>Capping Layer</td><td>0</td></tr>
</table>
</td></tr>
</table>

	<table><tr><th>Subgrade Soaked CBR%</th><th>Pavement Layer</th><th>Traffic Group A (10,000 esa) Layer Thickness (mm)</th><th>Traffic Group B (<100,000 esa) Layer Thickness (mm)</th></tr><tr><td rowspan="4">2-4</td><td>Surface</td><td>Seal*</td><td>Seal*</td></tr><tr><td>Base</td><td>100</td><td>100</td></tr><tr><td>Sub-Base</td><td>100</td><td>150</td></tr><tr><td>Capping Layer</td><td>200</td><td>275</td></tr><tr><td rowspan="4">4-7</td><td>Surface</td><td>Seal*</td><td>Seal*</td></tr><tr><td>Base</td><td>100</td><td>100</td></tr><tr><td>Sub-Base</td><td>100</td><td>150</td></tr><tr><td>Capping Layer</td><td>100</td><td>175</td></tr><tr><td rowspan="4">7-11</td><td>Surface</td><td>Seal*</td><td>Seal*</td></tr><tr><td>Base</td><td>100</td><td>100</td></tr><tr><td>Sub-Base</td><td>100</td><td>150</td></tr><tr><td>Capping Layer</td><td>0</td><td>100**</td></tr><tr><td rowspan="4">>11</td><td>Surface</td><td>Seal*</td><td>Seal*</td></tr><tr><td>Base</td><td>100</td><td>100</td></tr><tr><td>Sub-Base</td><td>100</td><td>150</td></tr><tr><td>Capping Layer</td><td>0</td><td>0</td></tr></table> * Seal can be either DBST or Otta seal / Penmac **Capping layer may be omitted if subgrade >10% Other options without capping layer, seal over armoured layer, and concrete surfacing are included as well
Drainage Design	Standard profiles, based on Manning Stickler calculations and rationale formula for catchment runoff calculations are included
Cross cutting issues	
Road safety	some attention in the EOD manual
Climate change	Not specifically
Standard Drawings included?	Not included
Specifications included?	Specifications included, based on AASHTO

Annex 4: Opening and closing speeches

Opening Address delivered by Honorable U Kyaw Lin , Deputy Minister, Ministry of Construction at the opening ceremony of the workshop for Review of Low Volume Rural Road Standards and Specifications

Good Morning ,
Distinguished Guests,
Ladies and Gentlemen,

First of all , I would like to express my heartfelt appreciation and warmly welcome to all people attending today opening ceremony. And also I am very glad to meet you and proud by myself for delivering the opening address.

As you all are aware, our ministry was reorganized and assigned as the Focal Ministry for National Rural Road Development in order to intensify its efforts in undertaking rural road development and poverty reduction activities ,in close cooperation with local and international experts, development partners and civil society organizations.

Department of Rural Road Development (DRRD) , under Ministry of Construction is implementing rural roads and bridge to develop the rural area. There are Sixty Three Thousand , Eight Hundred and Eighty Nine villages in our country and total length of rural roads are Fifty Three Thousand , Eight Hundred and Seventy Four miles and Three furlong. In Currently , 22% of all registered villages are connected by higher-level roads, 28% are connected by all-season rural roads, 36% are connected by dry-season rural roads, and 14% have no road access at all. Our ministry has developed national strategy for rural road and access to achieve our national goals, inclusive development and sustainable growth.

In line with National Strategy for Rural road and access , We must undertake the construction of rural road and bridge as well as monitoring , Quality Control and Research .We need technical and research for rural roads and bridges design and these design will make of climate resilience design. On 5th January 2017 , ReCAP and DRRD signed MoU to grant GBP(1.15) million for research program. In this program include rural road research , rural transport services research , capacity building and training , Knowledge management and transfer.

In Current stage ,We are preparing first five years business plan and review of rural road and bridge design standard and specification. The result from this workshop will support to publish for Low Volume Rural road and bridge design standard and specification manual.

we have organized Rural Road Research Technical Committee (RRRTC) , Research Development Unit (RDU) and Steering Committee for rural road research inclusive line ministries , technical universities and non government society(NGO). We will proceed to research for Rural Road and Bridges standards and development of a low volume rural road design manual, Road protection measures (drainage and slope protection) , Geometric design guidelines for rural roads, Road surfacing trials performance monitoring, Assessment management , Climate adaption of rural road networks , Best practice guidelines for the maintenance of rural roads.

In Conclusion , I look forward to working with you here today, with an ambition to meet Myanmar Rural Road Research development .I would like to say all of participants , please share to us from your knowledge and experience for rural road. For attending the workshop , I specially thank to ReCAP , Development Partners , representative of Ministries and Universities.
Thank You.

Opening Remarks by Les Sampson, Technical Team Leader, ReCAP

Honourable ……..
Chief Engineer
Chair, and members of the National Steering Committee,
Colleagues,
Ladies and gentlemen,

It is a great honour and privilege to be here today on the occasion of this stakeholder workshop for the Review of Low Volume Roads Standards and Specifications in Myanmar and to provide a brief overview of ReCAP (Research for Community Access partnership) made up of the Asia Community access Partnership (AsCAP and the Africa Community access Partnership (AfCAP) and the involvement in Myanmar represented by the Department of rural road development of the Ministry of Construction as a member of the AsCAP and ReCAP family.
I would also like to join the previous speakers in welcoming you to this workshop as part of this Asia Community Access Partnership workshop.

ReCAP is a UKAid funded research programme that supports research into rural road infrastructure and transport services in both Asia and Africa and is managed on behalf of the UK Department of International Development (DFID) through UKaid funds by Cardno Emerging Markets in the UK. The current phase of ReCAP runs until 2020 and builds heavily on the experiences of previous research programmes such as SEACAP (the South East Asia Community Access Programme) which ended in 2009 and AFCAP phase I (which ran from 2008 till 2014).

My name is Les Sampson and I am the Technical team leader for the Research for Community Access Partnership (ReCAP) which includes AsCAP (now covering 5 Asian countries which includes Myanmar) and the Africa Community Access Partnership (AfCAP now covering 12 countries). I am joined today by three other colleagues from the programme for this important workshop

- Dr Jasper Cook who is well known in Myanmar and is now the Chief Scientific Adviser to the programme looking at strategic and technical quality support to the programme.
- Maysam Abedin who is now the Regional Technical Manager for Asia and the responsible manager for projects in Myanmar; and
- Dr Nandar Kyaw who supports Maysam as country technical manager in Myanmar

ReCAP started in August 2014 and is now in the second half of the 6 year programme. The budget for the programme is about £26m over the six year period of which approximately two-thirds is planned for AfCAP and one-third for AsCAP based on the maturity of the programmes and number of member countries in each of the Partnership Programme.

AsCAP was a new initiative at the start of ReCAP and currently comprises 5 members, Nepal, Bangladesh and of course Myanmar which have been members since 2015 and Pakistan and Afghanistan which are new member countries . end of this year but the new countries are still under discussion.

As we move into the second half of ReCAP we have also looked at our strategy for the final 3 years and I would like to give you a brief overview of where the focus will be as we move towards the end of July 2020.

The Way Forward Strategy to 2020 and beyond is seen as being within a ReCAP research framework that is re-focussed on a Sustainable Rural Mobility theme that works alongside parallel initiatives aimed at the achievement of key global Sustainable Development Goals that are impacted by rural transport. ReCAP is therefore positioning itself to be the key link between high level strategic thinking and on-the-ground practical achievement related to research and knowledge generation for rural access and mobility.

The ReCAP drive towards sustainable rural mobility will be through the three principle research targets:

- Provision of rural access
- Preservation of access
- Effective use of rural access

Cutting across and supporting these three targets are three key support themes which I know have great significance in Myanmar. These are:

- Capacity Development
- Knowledge Management
- Gender Balance

In terms of ReCAP initiatives, moving through to 2020, and the achievement of the rural mobility aims ,the overall strategy will focus on the following:

1. Building-on and expanding the flagship regional initiatives on Asset Management, Climate Impact, Access Planning (index), Back Analysis.
2. Major initiatives on Capacity Development and Knowledge Management through a continued focus on Research Centre development and projects such as the LDP and CBA.
3. Stronger linkage between regional and inter-regional projects and national programmes.
4. A necessary focus on newer partners in both AfCAP and AsCAP in terms of national projects whilst the more research-mature partners remain involved with the larger regional initiatives.
5. Continued support of ARTReF and equivalents in South Asia but at the same looking outside the current ReCAP family to increase our uptake through initiatives such as SuM4All.

As I'm sure you will realise, through the ReCAP umbrella, it is now possible to consolidate and share all the knowledge and experiences from both Asia and Africa for the benefit of all member countries and this is a very important strategic intervention for ReCAP. This was demonstrated though our 1st Inter-regional Implementation meeting (IRIM) in Uganda in November 2017 attended by representatives from Myanmar. The meeting was attended by all ReCAP member countries and many service providers and practitioners to share experiences and learn from each other. The meeting was considered a huge success and will be repeated in early 2019. No decision on venue has been made yet as to the venue of the second meeting.

I would now like to spend a few moments giving a brief overview of our current activities in Myanmar.

Priority projects were identified as part of the scoping exercise completed in 2016. Based on the priorities, the following have been moved towards:

- The business plan for the Research Development Unit has been completed and RecAP is now looking at the support in terms of capacity Building and mentorship it could provide to support the establishment of the fledgling unit.
- The project we are discussing today, The Review of Low Volume Road Standards and Specifications; leading to the development of a LVR design manual for Myanmar is at a critical stage; and
- We are currently putting together a project to scope the relevance and introduction of the AfCAP DCP-DN design method to Myanmar. The use of the DCP is not new but it's development in providing a reliable and cost-effective design method in countries in Africa will be investigated for Myanmar.

- Other priority projects are now also being considered and concept note being developed in line with available budget for Myanmar as part of the ReCAP programme.
  I will leave the introduction and objective of the project and the structure of today's workshop to the Consultant (Rob Dingen) and his assistant (Tara Sann). However, as representative stakeholder in Myanmar, it is your workshop and I would like to personally encourage you to participate in the discussion during the course of the workshop. All comments are gratefully received and will be considered. On behalf of the ReCAP PMU, thank you for the opportunity to provide an overview of what is currently happening in ReCAP and I look forward to further workshops of this kind to gather the important inputs and contributions from you the stakeholders and users of the research outcomes.

  Good luck with the discussions today and also with the future successful implementation of the knowledge generated from the AsCAP research projects.

  Thank you Chair.

Closing Remark by U Khin Thet , Director General of DRRD for Workshop on Review of rural road standards and specification

Good Evening

Distinguished Guests,

Ladies and Gentlemen,

I am very glad to meet you and proud by myself for delivering the closing remark.

Firstly I would like to say all of participants, I 'm thankful to all of you for sharing their knowledge and experience at workshop today.

Currently , In my country needs to implement the infrastructure for rural road and needs to study research for all of sectors. According to different type of topography , My country is effected by natural disaster in every years. Due to climate change , most of rural roads are damaged in every year. So we need to provide resilience design for rural road.

I hope that outcome of these workshop support to make for rural road standards and specification design manual and way forward for rural road development.

DRRD closing cooperation with ReCAP , development partners and relative ministries for research If we finish the design manual for rural road , we will share and deliver to relative ministries , technical universities and development partners

In conclusion ,for attending the workshop and sharing knowledge for rural road research development , I specially thank ReCAP , Development Partners , representative of Ministries and Universities.

Thank You.

Annex 5: Workshop Evaluation

Evaluation sheet:

Your organisation / level: no need for your name or function, just level (District,State/Region or National) if from a ministry, Which ministry? Or academic institution/ professional body/ commercial/ donor organisation/ project consultant, etc:

_____

1. How useful was this workshop? (tick)							
Very Useful		Useful		Not so useful			
Comments:							
How interesting did you find the sessions? (Rank 1 to 10)							
2. Setting The Scene (by Dr Cook)							
Comments:							
3. Findings from the review (presentations)							
Comments:							
4. Group work on standards and specifications							
Comments:							
5. Outline for phase 2: development of the LVRR manual for Myanmar							
Comments:							
6. Action Plan and arrangements							
Comments:							
7. Would you like to be involved in the development of the guidelines or manual for LVRR in Myanmar			Yes			No	
How would you like to contribute?							

Scoring by session

Workshop Evaluation - consolidated

Designation:
A = Academic or professional body
B = Ministry level
C = State and District DRRD staff
D = Donors and Consultants

Session/topics	Respondents:	Counts	Average Overall	A 1	A 2	A 3	A 4	A 5	A 35	A 36	Average A
				scores / counts							
1. How useful was this workshop?	*Very Useful*	22	55%	0	1	1	0	0	0	0	29%
	Useful	19	45%	1	0	0	1	1	1	1	71%
	Not so useful	-	0%	0	0	0	0	0	0	0	0%
2. Setting The Scene (by Dr Cook)		129.0	7.2	7	9	8		8	6		7.6
3. Findings from the review (presentations)		108.0	7.2	7		8		7	8		7.5
4. Group work on standards and specifications		121.0	8.1	8		9		8	8		8.3
5. Outline for phase 2: Development of a LVRR manual for Myanmar		98.0	7.0	7		8			7		7.3
6. Action Plan and arrangements		83.0	6.8	7		7			7		7.0
7. Would you like to be involved in the development of the guidelines or manual for LVRR in Myanmar	*Yes*	36.00	95%	1	1	1	1	1	1	1	100%
	No	-		0	0	0	0	0	0	0	

Session/topics	Respondents:	B 6	B 7	B 8	B 9	B 10	B 11	B 12	B 13	B 14	B 15	B 16	B 17	Average B
1. How useful was this workshop?	*Very Useful*	1	1	0	0	1	0	1	0	1	0	0	1	50%
	Useful	0	0	1	1	0	1	0	1	0	1	1	0	50%
	Not so useful	0	0	0	0	0	0	0	0	0	0	0	0	0%
2. Setting The Scene (by Dr Cook)			10		8	5		9	5		5			7.0
3. Findings from the review (presentations)			8		7	8		9	7		6			7.5
4. Group work on standards and specifications			8		8	8		8	8		4			7.3
5. Outline for phase 2: Development of a LVRR manual for Myanmar			8		7	8		8	6		3			6.7
6. Action Plan and arrangements			8		8	8		9	5		2			6.7
7. Would you like to be involved in the development of the guidelines or manual for LVRR in Myanmar	*Yes*	1	1	1	1	1	1	1	1	1	1	1	1	100%
	No	0	0	0	0	0	0	0	0	0	0	0	0	

Session/topics	Respondents:	C 18	C 19	C 20	C 21	C 22	C 23	C 24	C 25	C 26	C 27	C 28	C 29	C 30	C 31	C 32	C 33	C 37	C 38	Average C	D 34	Average C
1. How useful was this workshop?	*Very Useful*	0	1	1	1	0	1	1	0	0	0	1	0	1	1	1	1	1	1	67%	1	100%
	Useful	1	0	0	0	1	0	0	1	1	1	0	1	0	0	0	0	0	0	33%	0	0%
	Not so useful	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0%	0	0%
2. Setting The Scene (by Dr Cook)			6	*8*		*8*	6				*6*						7	7		6.9	8	8.0
3. Findings from the review (presentations)			8	*8*		*7*					*5*									7.0	5	5.0
4. Group work on standards and specifications			9	*9*		*8*					*9*							8		8.6	9	9.0
5. Outline for phase 2: Development of a LVRR manual for Myanmar			5	*7*		*8*					*8*							7		7.0	8	8.0
6. Action Plan and arrangements				*7*		*8*					*7*							6		7.0		
7. Would you like to be involved in the development of the guidelines or manual for LVRR in Myanmar	*Yes*	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	89%	1	100%
	No	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	

5 *scores corrected. Respondents reversed the scoring*

Workshop Evaluation - consolidated comments

1. Usefulness of the workshop
The outcome from the workshop will be beneficial for the construction and design of rural roads in Myanmar.
I now know the process of partners organization (AsCAP, ReCAP) for the rural development of Myanmar/
To specify of Rural Road standards for Myanmar
We obtained more knowledge about the existing conditions of rural roads and how to improve the design standards, construction method and properties of construction materials.
We received information from different departments and different people
Variations in conditions by Location, Soil and environments, therefore rural road standards and specifications should be diversified by region
This workshop was very useful because we obtained suggestions from participants (Departmental , project consultant and Organizations)
Good to hear about the various conditions in Myanmar
Rough in facts and not based on realistic conditions in Myanmar
Result will support standards and specifications for rural roads
I think it will be useful for design for the DRRD.
This is useful for standardization of various steps
It is a good cooperation and discussion between the stakeholders to get the effective results for LVRR manual developments
We upgraded our knowledge in LVRR
Because the whole workshop shows how to design the pavement, geometrical design standards, and leading to rural roads standards and specification for Myanmar
We can collaborate with each other to come to solutions
The information from the workshops can be linked with field level implementation
Great! I felt good time for DRRD.
Useful for DRRD Manual in Myanmar and also for the Department
I obtained useful knowledge
Nice to hear the discussions. This workshop being combination of design ('head office') and field discussion.
This workshop useful for me. I want a knowledge basis for design and implementation of roads in Myanmar and all over the world. I compare the result from this workshop. Thanks.
I've learnt a lot about LVRR standards and specifications in this workshop.
Knowledge sharing by well experienced person
It should be considered to make rural roads specifications workshop annually.
Can get Knowledge
Knowledge sharing by well experience persons
Having design knowledge and new ideas for various subjects.
Very useful
2. Setting The Scene (by Dr Cook)
This presentation describes the factors to be considered in doing manual for LVR. These must be followed.
Presented for their organization process and supported which target part of Myanmar.
Knowledge sharing gives us consideration of rural roads and environments

(1) Application of appropriates Geometric standards,(2) Pavement Option (3) Use of Arial materials (4) Current and future climate impacts
Appropriates design approach should be based on classification standards, technical specifications, Design Manual more over, availability of local material should be consider.
Went to move present by using pictures andy places
100% interesting
Rank 4 is selected by me
Very Interesting presentation
It's Ok
Geometric and Paving interested not in Hydraulics
It is a suitable setting of scenes in this workshop
We got some knowledge and adopt the result of his presentation.
Very good
Good. But some difficult to understand the language of my listening skill
I get knowledge of sustainable rural road design development
I am interested in Dr. Cook's explanation, ADB ideas on standards and the work presentation between ADB and DRRD.
For our department , you sharing the ideas of you known and your ideas on standards are very interesting to care.
All the sessions are interest.
Session 4 and 5 are detail.
Very good and interesting
Good ideas.
8/10 Geometric design
For our department, for your sharing ideas are good.
3. Findings from the review (presentations)
These finding are used for LVRR Manual.
Presented with clear facts and represented the whole work of their organizations.
All assess to consider for rural roads
Need to carry out the required test to meet the designs standards, safety requirements and improvements
Presentations are useful for transportation engineers as we get more knowledge about rural roads standards
Hydraulics and Hydrology design standards are very good for me
Specifications may vary by roads environments, Specifications are draw up by contracts to ensures uniformly and quality control works
Very good
We can know the other countries LVRR manual such as Laos, Cambodia
According to previous design method used in DOH, 3 % Camber for concrete road should be change to 2 % if you think about aountain and dry zones
Good presentations
Get knowledge LVRR design
Rural Roads are mostly damaged by overload that cannot be counted
We have gotten useful facts and data from group discussion

Field observation and local conditions . Observation is very useful for design standards and specifications
The design concept comparison between African countries (Tanzania, Malawi, some Asia countries Laos) we know the knowledge about these manual.
The review is very good presentation for rural roads.
Review of Road standards in Myanmar and other countries rural
Well done.
Knowing Geometric design standards and drainage and hydraulic design standards and pavement design standards . Different between review off rural roads standards and specifications in Myanmar and other countries.
I am very glad to attend this workshop for getting concept of rural road development design and strategy
Useful knowledge
Dry, Delta, Mountain areas come from different situation . We try to translate from your presentation some more.
Because of review sharing, I 've known LVRR & other roads standards and specifications are more and more.
Very useful information for practical and our worksite.
Good and get many knowledge
5/10 hard to understand all due to language barriers but half understanding from handouts.
4. Group work on standards and specifications
Standards and Specifications must be prepared for different regions , wet zones, dry , delta, mountains.
Knowledge sharing suggested and comments from different organizations and departmental officers.
We get various information and how to consider
We can get appropriate geometric standards and construction methods and materials depends on the local materials
We all are consider from different points of view for standards and specifications
Group -1 , Geometric Design standards
Yes, Existing standards and specifications is good for Dry Delta and Mountain regions . Among them , high interesting in Mountain regions
We can get idea from various level
Design method for pavement design calculation, we should think about soaked CBR & Bsiti CBR compare with field CBR test rather DCP which can be variable result on the user operation.
Must do design for corresponding regions
I learnt much from Groupwork discussion
Very knowledgeable work
Too little time for discussion
We should study design standards (Geometric design) from any references
We know about unity, knowledge sharing , design concept data from anyone of participant who came from the whole part of Myanmar.
Very interested and learn the specifications from discussions.
Good job, we work great together and sharing experiences.
Useful
The group work on standards and specification discussion were very useful for DRRD in Myanmar
Sharing of Knowledge
Standards and Specification establish theory which is not the same as in the field. The group work may get good results.
Groupwork leads to get unity and knowledge.
Very good idea for coordination and attention participate.
Good very useful for our departments
Can get ideas on others

9/10 excellent (all subjects) , happy knowledge.
5. Outline for phase 2: development of the LVRR manual for Myanmar
The group discussion from different groups must be considered in the development of the LVRR Manual.
Needed / essentially for the Myanmar rural area.
Need information for Myanmar
Both Staged development and Leap frogging
Implementation and project management more
Guidelines for the optimum utilizations of local matters , Road and build standards and development for LVRR road designs, Best Practices Guidelines for the maintenance of Rural roads
We hope it will be useful for DRRD and MOC
SN method should be detail so much to refer sites conditions, so, ORN 31 prefer for references
Allow more time to fully understand the Myanmar Economics development and the impact on road transport
It is a suitable time schedule for development of LVRR manual
Implementation strategy -----> should be based on current Myanmar situations ----> scenarios
We need to make sure workshop, discussions, field condition survey and need more to study.
It is very effective for development of the LVRR manual for Myanmar.
I didn't understand well.
I should do many workshops for LVRR manual for Myanmar.
I now understand the planning of Rural Road Design
Nearly necessary the LVRR manual for Myanmar from our discussion results.
I wish the development of the LVRR manual for Myanmar to be a success
Outlines for phase 2 is very useful for development of the LVRR for Myanmar.
Good guidelines for rural roads implementation, we can use for villages knowledge sharing.
it is suitable
8/10: recommend to be developed
6. Action Plan and arrangements
The traffic volume survey, the soil investigation and properties of materials must be rented out for different regions.
To adjust with the suitable local requirements and the standards and functional partners organization.
To check week conditions and how to improve the appropriate condition
Proposal, Framework
Action Plan is good for project
We hope to complete before specific time
Good Plans
More researches are needed to adopt input factors for DRRD design should be based on the existing standards
I think April 2018 is not possible. It is not very easy.
Action plan and Arrangements are quite enough for DRRD
You should do according to plan

Very Good plan and arrangements.
I should apply and be considered in our future plan.
I know 5 action plan milestones, 5 section plans are much appreciated. The outcomes from this workshop are suitable for Myanmar.
May be satisfied.
Want to cooperate the LVRR manual for Myanmar.
Need to study for new and high technology.
Good. We hope sustainable rural roads developments.
It is a good plan.
May be satisfied.
7. Contribute in the development of the LVRR manual
I will contribute in the development of the guidelines of the reviewing the results which are obtain from the action plan.
yes
Contribution around all areas in Myanmar, Research development in Myanmar more and more
Any sectors ,except hydrology
To develop rural road manual
Rural roads standards and specifications are very important for DRRD, We will coordinate with ReCAP
Sharing knowledge in my department
What will help you , if you wish
We have some technical Data used in ADB and JICA , It will be useful as our country data for your manual
Anyway you want
I can advise with my knowledge and opinion
Contribute discussion Geometric design standards
Can Join the next Workshop, can approve the data from the department as usual
I will contributed in the development of the manual of LVRR as a Deputy Director General, DRRD willingly
I would like to contribute design standards from some references.
I would like to help to get data of my regions, Rakhine district, Rakhine states by anytime.
I would to contribute how I can.
I like for contribution because I know many knowledge.
I become to make rural road design and know how to think for development.
Knowing how to develop rural roads in Myanmar. Getting knowledge between Myanmar and Africa.
So many interest in this workshop and I want to construct very useful rural roads for rural citizen.
This workshop is useful for me . I would like to thanks for leaning and listening. And this workshop is important for rural roads.
I would like to contribute from our ministry policy and guidelines. I would like to try , I awarness from our meeting and discussion.
Because I am government servant. And I want to improve my country and citizens.
Suitable

Annex 6: Workshop Impressions


AsCAP
Asia Community Access Partnership
UKaid
from the British people
Workshop on
Review of Rural Roads Standards and Specifications
in Myanmar
PARKROYAL


AsCAP
Asia Community Access Partnership
UKaid
Workshop on
AsCAP
Asia Community Access Partnership