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Report II Assessment of Maintenance Manuals

Appropriate and Efficient Maintenance of Low Cost Rural Roads

Report II Assessment of Maintenance Manuals

February 2000

The University of Nottingham
School of Civil Engineering
University Park
Nottingham
NG7 2RD
United Kingdom
www.nottingham.ac.uk/p&g

Roughton International.
321 Millbrook Road West
Southampton
SO15 0HW
United Kingdom
www.roughton.com

University of Birmingham
School of Civil Engineering
Edgbaston
Birmingham
B15 2TT
United Kingdom
www.bham.ac.uk/CivEng/

DFID Department for
International
Development

Department for International Development
94 Victoria Street
London
SW1E 5JL
www.dfid.gov.uk

**Department for International Development
Knowledge and Research (KaR) Programme**

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Malawi

Mr	Kachiwala	Deputy Director of Roads
Mr	Chirwa	Assistant Municipal Engineer
Mr	Mwakhwawa	Director of Roads
Mr	Chingoli	Lilongwe City Council
Mr	Kalea	Commissioner for Local Government
Mr	Nambuzi	DRIMP Supervisor
Mr	Kasaila	Public Works Officer
Mr	Kunkeyani	Assistant City Engineer
Mr	Simcock	EC Technical Assistant
Mr	Phiri	Jatula Partners
Mr	Kara	Secretary for Works and Supplies

Nepal

Mr	Millband	MRCU
Mr	Finn	Roughton (EROM)
Mr	Strestha	EROM2
Mr	Strestha VP	EROM2
Mr	Lama	EROM2
Mr	Chalise	MRCU
Mr	Cripps	Traffic & Driver training services
Mr	Dhungana	Biratnagar DOR
Mr	Thapa	DDC Morang District
Mr	Pearce	EROM 2

Uganda

Mr	Trizi	District Engineer	MoWTC District Station – Arua
Mr	Onep	Warden Engineer	Murcheson Falls National Park
Mr	Ozele	District Engineer	MoLG District Feeder Roads – Nebbi
Mr	Mugisha	District Engineer	MoWTC District Station – Masindi
Mr	Asaja	District Engineer	MoWTC District Station – Luwero
Mr	Musoke	District Engineer	MoWTC District Station – Kampala
Eng	Kinyera	Deputy City Eng.	Kampala City Council
Mr	Lutaaya	Commissioner	MoWTC
Mr	Mohammad	Planning and monitoring	MoWTC

Mr	Ssebugga	Central Principal Engineer. MoWTC
Mr	Ojuka	Assistant Commissioner MoWTC - District and Urban Roads.
Mr	James	ADB rural feeder roads Roughton International Ltd. maintenance programme
Mr	A Musoke	District Engineer MoWTC District Station – Mpigi
Mr	P.B. Balamu	Assistant Commissioner MoWTC for Eng. Construction
Mr	Katendi	Inspector of Works – Mukono District Local Government Roads

Belize

Mr	Henderson	Deputy Chief Engineer, MoW.
Mr	Aleman	Maintenance Unit
Mr	Cuellar	Maintenance Unit
Mr	Segura	Maintenance Unit
Mr	Moore	MoW - Toledo
Mr	Allison	Beca Consultant
Mr	Mawson	Beca Consultant
Mr	Guerreo	Private consultant
Mr	Workman	Roughton International
Mr	Sargeant	Roughton International

Fiji

Mr	McNaughton	Maintenance Engineer, PWD
Mr	Ratu Seru	PWD Depot – Taunovo
Mr	Moidean	PWD Depot – Naqali
Mr	Etuete Bari	PWD Depot – Rewa
Mr	Joep Matatou	PWD Depot – Korovou

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EXECUTIVE SUMMARY

To address the goal of “Appropriate and Efficient Maintenance of Low Cost Rural Roads in Developing Countries” Element A of this research has been an investigation into maintenance issues. The research focuses on constraints to maintenance, which currently result in inefficient and inappropriate maintenance regimes and on technical aids to maintenance in the form of manuals.

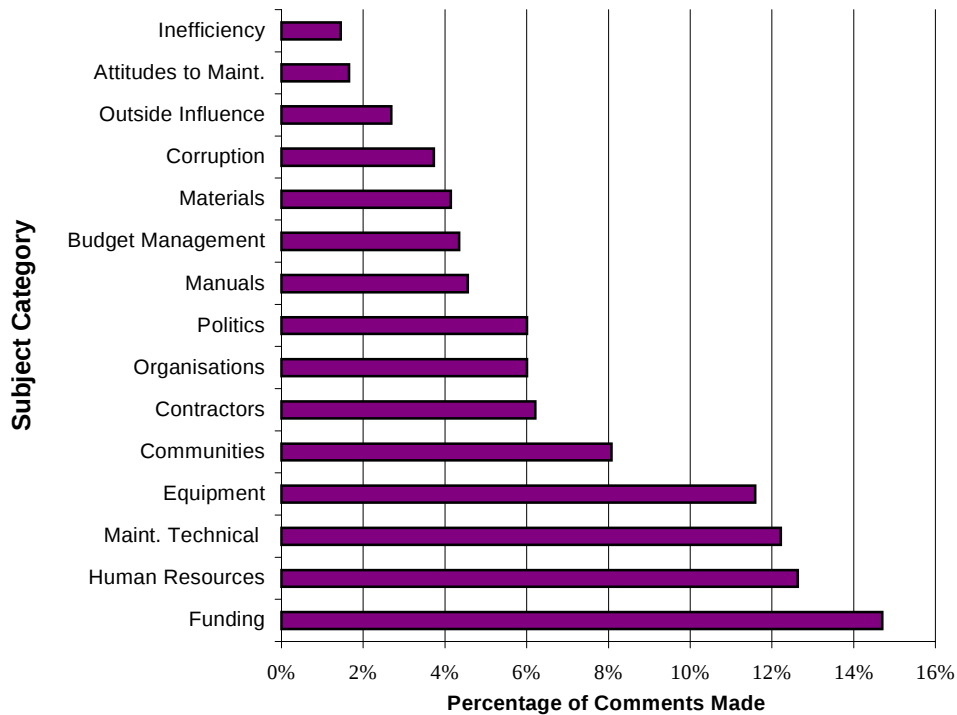
Unlike previous work in this area, the research has been conducted in a qualitative rather than quantitative manner. The research has sought to help clarify a complicated, dynamic and inter-related problem environment using an established Operations Research methodology, and thereby provide insight and suggest approaches that may prove the source of more sympathetic, innovative and sustainable solutions to rural road maintenance. The research explored the unstructured perceptions of a range of practitioners to identify those issues that raised most “anxiety”, and analysed these issues and the manner in which they were raised.

The research was undertaken by conducting a literary review of existing documents, and a series of unstructured interviews with a group of 100 people considered to be practitioners and possibly “experts” in this field. Interviewees included high, medium and low level professionals from five developing countries and a number of expatriate consultants. Data gathered from these interviews was then analysed to investigate its inherent structure and content along with an analysis of the overall nature of issues raised.

Interview data was analysed using the SODA (Strategic Options & Analysis) methodology, and Cognitive Mapping in particular. This methodology enables a range of perceptions to be collated into a single group perception of a problem that may require a portfolio of actions rather than a single solution. This approach allowed subjective ideas from a range of cultures and environments to be captured into a cohesive and understandable whole, and has resulted in a description of the problem environment that was reached through consensus and full participation.

Using more traditional quantitative analysis techniques on the interview data, initial analysis of the subjects raised by interviewees tended to support traditional rankings of key issues constraining the sector. As expected these are funding, human resources, technical issues and equipment in descending order of importance as shown below in Figure ES1.

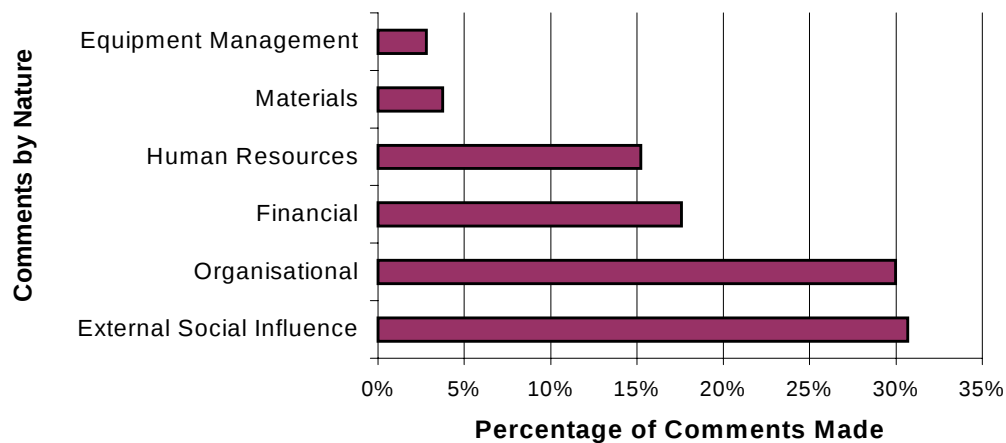
Figure ES1 - Interview Subject Analysis



However using SODA and cognitive mapping it was possible to objectively identify 9 issue areas that could be addressed in comparative isolation, and more importantly identify trends and nuances that resulted from the cultural and social dimensions of the problem.

This social aspect of the analysis reveals that external social influences and organisational influences dominate the key issues raised as shown in Figure ES2.

Figure ES2 – Interview Analysis by Nature of Comments



This implies that appropriate and efficient solutions can only be found by first understanding the social and organisational environment, and then fully incorporating them into the development process. The research strongly suggests that there is no generic solution the problem, but that bespoke maintenance regimes will have to be developed for each specific social and organisational environment. The research also suggests that indigenous solutions should be allowed to evolve from the bottom-up, but must be complimented by first

developing appropriate enabling environments of good governance and stakeholder participation.

Overall the approach has shown that there is a need to adopt improved methods of research, planning, management, monitoring and evaluation that fully incorporates the social dimension of the road sectors impact environment. This will be new to engineers. A number of established techniques and methodologies are available from other sectors and disciplines, but further work is required to collate and assess these, and produce suitable practical tools for practitioners in the field.

The following report for Element A covers two issues in detail, Report 1 addresses constraints to maintenance, and Report 2 an assessment of maintenance manuals and includes a short guide on what to consider when preparing a manual.

REPORT II – MAINTENANCE MANUALS

ACKNOWLEDGEMENTS

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BIBLIOGRAPHY

REFERENCES

1. INTRODUCTION

The DFID funded project “Appropriate and efficient maintenance of low cost roads in developing countries”, is a series of reviews with recommendations for improving the maintenance of low cost roads. It was originally expected that one of the outputs would be a manual incorporating the results of the study but as the project proceeded this objective was changed following publication of the new Overseas Road Note (OSRN) by the Transport Laboratory (TRL).

The project had already collected and reviewed a wide range of existing manuals as part of a literature search and the use of manuals featured in the interviews with maintenance engineers and their staff. It was decided that the results of this phase of the study should be published as an aid to donor organisations, consultants and senior managers working with developing countries.

The aim of this report is to provide background information on a range of manuals and a suggested checklist of features that make up a ‘good’ manual.

2. METHOD ADOPTED AND ASSESSMENT

2.1. Method Adopted for Assessment

A number of maintenance manuals of various types were obtained from a number of sources, many from the ILO ASIST database. The ones chosen were done so because the titles seemed interesting and relevant, (the reason was not a scientific one). The aim is not to criticise any manual, but to learn from their contents. Each manual was produced to meet a particular situation which hindsight cannot appreciate.

2.1.1. Basis of the Method Adopted

Due to the vast quantity of manuals available, locating good and bad examples is not necessarily an easy task. It was decided to assess a proportion of the manuals gathered. One reason for obtaining the manuals was to get an idea of the different types available (remembering of course that other types may exist which were not been located). By obtaining an idea of what is available, it is possible perhaps to identify what is good and bad. The problem with undertaking such an assessment is that it is highly subjective. The most effective way to assess whether the manuals are indeed useful and helpful, is to go and see if they are used in practice and speak to a wide range of users. Such a task would require a significant amount of time and resources. A limited amount of information came from interviews with users, but these were not correlated with specific manuals.

The task undertaken therefore sought to look at the manuals and consider what they contained. After looking at the contents of the manual, general observations have been made about the overall ease of use etc. The assessment criteria headings used to investigate different documents, were as follows:

- General information
- Proposed audience
- Aesthetics of manual
- Structure of the manual
- Scope of the manual

2.1.2. General Information

General information refers to the overall appearance, languages the manual is available in, authors, publisher, date of publishing etc.

2.1.3. Proposed Audience

Observations on whether or not it might be useful to the proposed user, or if it does not state the user a guess at whom it might be. For example if the manual is supposed to be taken into the field, would it fit inside the user's pocket?

- Who is the document aimed at and is it suitable?
- Are complex tasks defined adequately?

2.1.4. Aesthetics of Manual

The aesthetics of the manual were assessed by considering such issues as:

- Size/ colour of the manual
- Type of manual (hardback/ paperback/ loose-leaf)
- Number of pages, chapters
- Size and type of text

Next the visual aids were considered, as it was felt these were a very important part of any manual. The following issues were considered:

- Number and quality of photographs
- Number and quality of tables, diagrams, figures, graphs etc
- The use of annotation

2.1.5. General Information

General information such as the number of Authors, publisher, were also noted.

2.1.6. Structure of the Manual

The structure and layout of the manual were considered as it obviously affects the ease with which a manual may be read and understood. Factors such as the inclusions of a contents page, a Foreword, Introduction, numbering of visuals and lists of visuals were noted. Additionally, attention was paid to the length of chapters, the use of numbering, indexing and the provision of a reference list and bibliography.

The issue of providing blank forms was considered, as it was felt to be very useful, especially when blank forms were provided in a form which allowed them to be simply photocopied for use in the field.

The language in which the manual was written was felt to be important, as a manual which was written in English in a country where the first language was perhaps French, was not going to create ownership.

The quality of the manual, with regard to the visuals (ease of understanding and quality of image) was considered. Issues such as whether or not the information flowed and the messages were adequately given and explained were also considered.

2.1.7. Scope of Manual

The scope of the manual, was obviously the most important part of the assessment process. The first issue to be considered was whether or not the manual covered maintenance and/ or construction. The aspects of maintenance and construction covered were then considered:

- a) Pavements – (unpaved and paved)
- b) Shoulders
- c) Drainage
- d) Bridges
- e) Maintenance methods and Routine/ Periodic maintenance
- f) Structures and street furniture/ signing/ roadmarkings
- g) Materials
- h) Traffic management
- i) Staff issues
- j) Maintenance management – programming/ Maintenance Management System/ inventories/

Consideration was given to whether the information provided was sufficient to allow the reader to set up the systems and undertake the activities specified, or whether it only gave an overview and could be considered as an insight rather than an instructional manual.

3. MANUALS

A number of manuals pertinent to the research were obtained and a selection were assessed. The following list details the manuals obtained, with the assessed ones being written in **bold** type.

Table 1 - Manuals Obtained

Country	Author/ Organisation	Title of Manual or relevant publication
Australia	ARRB	Sealed Roads Manual
Australia	ARRB	Unsealed Roads Manual
Australia	Giummarra	Guidelines to good practice for the construction, maintenance and rehabilitation of pavements.
Benin	Scott Wilson Kirkpatrick	La Brigade Legere
Botswana	Republic of Botswana	Technical Manual - District Road Unit.
Botswana	Republic of Botswana	Maintenance Training Manual
Botswana	Johansen, R	Management and supervision of labour based road construction and management.
Cambodia	Johannessen	Field manual for labour based road supervisors.
Ghana	COWI Consult	Maintenance performance budgeting system.
Indonesia	Beusch, Hartman et al	Low cost road construction in Indonesia Volume 1
Indonesia	Beusch, Hartman et al	Low cost road construction in Indonesia Volume 2
Indonesia	Government of Indonesia	Technical manual for implementation of routine road management using labour intensive methodology.
Kenya	Petts	Minor Roads Programme Vol 1 - Technical Manual.
Kenya	Petts	Minor Roads Programme Vol 2 - Maintenance Manual.
Kenya	Petts, Beusch	Roads 2000 works manual.
Kenya	Republic of Kenya	Road maintenance manual Part 1 - Induction course for overseer trainees.
Kenya	Republic of Kenya	Road maintenance manual Part 2 - Overseer course.
Kenya	Republic of Kenya	Road maintenance manual Part 3 - Overseer 1 course.
Kenya	Republic of Kenya	Road maintenance manual Part 4 - Foremans course.
Kenya	Waichanguru	Maintenance Inspectors Manual.
Kenya	Waichanguru	Maintenance Overseers Manual.
Laos	Marks	Maintenance management manual.
Laos	RFRM training project	Field manual - labour based rural feeder road maintenance
Lesotho	SIDA/ IT Transport	Technical Manual.
Malawi	Scott Wilson Kirkpatrick	Foremans site manual.

Country	Author/ Organisation	Title of Manual or relevant publication
Malaysia	Jalan, Cawangan	JKR – Guideline for the management of road maintenance contracts.
Nepal	His Majesty's Government of Nepal & ODA	Vegetation structures for stabilising highway slopes - A manual for Nepal
Malaysia	Jalan, Cawangan	JKR - Standard specification for routine maintenance of roads and structures by contract. 1997
Nepal Mountainous countries	TRRL	Overseas Road Note 16 - Principles of low cost road engineering in mountainous regions.
Papua New Guinea	Government/ Roughtons	A series of 8 road maintenance field manuals
South Africa	Natal Roads Department	Betterment and gravelling manual.
South Africa	Committee of State Road Auth	TRH 17 - Geometric design of rural roads
South Africa	Committee of State Road Auth	TRH 18 - The investigation, design, construction and maintenance of road cuttings.
South Africa	Committee of State Road Auth	TRH 20 - The structural design, construction and maintenance of unpaved roads.
Tanzania	ILO/ Intech	Appropriate Technology, Labour-based roadworks technical manual - Volume 1 Road Rehabilitation Works.
Tanzania	ILO/ Intech	Appropriate Technology, Labour-based roadworks technical manual - Volume 2 Road Maintenance.
Tanzania	Selvarasa, K	Manual on improvements/ maintenance of paths. Makete integrated rural transport project.
Tanzania	Saetrum	Hanna Nassif - Community Development Project - Manual on maintenance and drainage of roads.
Uganda	MoWTC	Road maintenance management guidelines
Uganda	MoWTC	DRAFT Maintenance manual
Zimbabwe	Department of State Roads.	Field manual for labour based road construction
Any country	Overseas Unit TRL	Overseas Road Notes 1
Any country	Overseas Unit TRL	Overseas Road Notes 2
Any country	PIARC	International Road Maintenance Handbook (IRMH) - Volume II (Maintenance of unpaved roads)
Any country	United Nations Economic Commission for Africa	Road Maintenance Handbook - Volume II (Maintenance of unpaved roads)
Any country	Overseas Centre TRL	Overseas Road Note 15: Guidelines for design and operation of road management systems
Fiji	Public Works Department	A variety of manuals relating to maintenance

3.1. Assessment of the Manuals

Each manual has strengths and weaknesses and the appropriateness of a manual can only be assessed effectively by taking account of the environment in which it was produced and subsequently used. Not all manuals obtained were written specifically for low cost roads but relevant lessons could still be learnt from the process of assessment.

3.2. Issues Arising from the Assessment

Institutional and Management Policy

A manual is only as good as the institution in which it exists. A poor manual in an institution which has policies and rules to enforce its use is more effective than a comprehensive manual which exists in an institution where no rules or policies exist. Manuals should only be produced where there is a clear institutional and management policy regarding the need for and intended implementation of the manual.

Ownership

Linked to institutional policy is the issue of ownership of the manual. Staff are more willing to use a manual where they have made an input and have a sense of ownership. The local customisation of a generic manual is a good way forward.

Circulation

There is still evidence of manuals failing to reach the target user. In spite of being available at no cost, the PIARC maintenance manuals are seen on the shelves of district engineers whilst the foreman (for whom it was designed) has no copy.

Training

Senior managers can usually understand and apply manuals where they are relevant, but most other senior staff will require formal training. The use of a manual must be seen as part of the agreed methodology of the organisation. The lack of training is obviously a serious problem.

Computer Support

Manuals that rely on using computers to store and process data are more at risk than those using paper systems. A number of people complained about the difficulty of acquiring and maintaining computers.

Maintenance Terms

An interesting anomaly from the assessment is that there seems to be inconsistency in the use of maintenance terms. Terms used to identify maintenance include: routine, recurrent, periodic and emergency. In some cases the term 'recurrent' is used, in others periodic and sometimes both terms.

Generic Manuals

The influence of the Overseas Road Notes and the PIARC manuals is apparent in the number of the manuals considered. They are both generic and the diagrams especially have been used in a number of other manuals written for specific countries.

3.3. Overview of the Content of the Assessed Manuals

A table has been produced which lists various aspects of maintenance manuals and whether or not they provide information relating to specific areas. Obviously such an assessment is subjective, which is why it was decided not to rate one manual against another.

Table 2 - Overview of Manual

Name	Suitability for audience	Aesthetics	Quality of Visuals	Structure Points	Languages	Maintenance	Construction	MMS	Staff issues	Surveys	Standards	Planning	Task Rates	Safety	Traffic manage	Plant & Equip	Emergencies	Sample worksheets	
1	Not applicable to this manual - written in French																		
2	MPBS	Yes	good	poor	6	english	B/ R/ D	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Little	No	Yes
3	Kenyan Manual Part 1	Yes	good	good	5	english	R/ D	Little (R/ D)	No	Little	Some	No	No	Some	No	No	Little	Little	No
4	Kenyan Manual Part 2	Yes	good	good	4	english	R/ D	Little	No	Little	No	Some	Little	No	Yes	Yes	Little	No	No
5	Kenyan Manual Part 3	Yes	good	good	4	english	Soil,R/D	No	No	Yes	No	No	No	Little	No	Yes	No	Some	Some
6	Kenyan Manual Part 4	Yes	good	good	4	english	R/ D	No	Little	Some	Little	Some	Some	Yes	Little	Little	Some	No	Some
7	Inspectors Manual	Yes	mod	poor	5	english	R/D (B)	No	No	Yes	No	No	Some	No	No	No	Little	Little	Some
8	Overseers Manual	Yes	moderate	poor	5	english	R/D (B)	No	No	Yes	No	No	Some	No	No	No	Little	Little	Some
9	Maintenance manual Laos	Yes	good	good	6	eng/Lao	R/D (B)	No	Yes	Some	Some	Some	Some	No	No	No	No	Some	Yes
10	Field manual Lao	Yes	good	good	6	eng/Lao	R/D (B)	Little	No	No	No	No	No	No	No	Little	Some	Little	No
11	Foreman's Site Manual	Yes	good	good	5	english	B/ R/ D	Some	No	Yes	Yes	Some	Some	Some	Some	No	Some	Some	Some
12	Not applicable to this manual - subject matter too specific																		
13	Not applicable to this manual - subject matter too specific																		
14	Field manual PNG	Yes	good	good	4	eng/png	B/ R/ D	No	No	No	Some	Some	Little	No	No	Yes	Yes	Some	No
15	Betterment & regravelling	No	mod	poor	2	english	R/D	Some	No	No	Little	Little	Some	No	No	Some	No	No	Some
16	Draft TRH 20	No	good	poor	7	english	R/D	R/D	Little	No	No	Some	Little	No	Little	Little	No	No	No
17	(Tanzania) Manual	Yes	good	good	5	english	Paths	Yes	No	No	No	Some	No	No	No	No	Yes	No	No
18	Hanna Nassif manual	No	mod	mod	5	english	R/D	No	No	Some	No	Some	Little	Some	No	No	Some	Some	Yes
19	Road maintenance guidelines	Yes	mod	poor	5	english	R/D	No	No	Little	No	Some	No	Yes	Little	Little	Some	Little	Yes
20	DRAFT maintenance manual	Yes	good	poor	4	english	R/D	Little	Yes	Little	Yes	Yes	Some	No	Yes	Little	Some	Yes	Yes
21	Overseas Road Note 1	Yes	good	good	6	english	R/D	No	Some	Some	Yes	Some	Yes	Some	No	No	Some	Yes	Yes
22	Overseas Road Note 2	Yes	good	good	6	english	R/D (B)	Little	No	Some	No	Some	Some	No	Yes	Yes	Yes	No	No
23	PIARC Volume II	Yes	good	good	7	E,F,S,P	R	Some	No	Little	No	Some	Little	Some	Yes	Yes	Yes	No	Yes
24	UNECA Volume II	Yes	good	good	7	english	R	Some	No	Little	No	Some	Little	Some	Yes	Yes	Yes	No	Yes
25	Overseas Road Note 15	Yes	good	good	6	english	No	No	Yes	No	No	No	No	No	No	No	No	No	No
26	Fiji manuals x 9	Yes	good	good	7	english	B/ R/ D	Yes	No	Some	Some	Some	Some	No	Yes	Yes	Yes	Some	Some

The reader should bear in mind that the scoring merely indicates whether or not the manual is good in relation to the criteria specified, and it has been specified with low cost roads in mind.

Therefore the fact that a manual does not score highly does not mean it is bad, simply that it is not good for the type of situation being considered.

General - Yes = 1 No = 0

Manual aesthetics - 1 = poor = difficult to use/find information

2 = moderate = reasonably easy to use, but certain aspects of manual are not easy to use

3 = good = easy to use with no real problems apparent

Use of visuals - 1 = poor = very low number of visuals such as diagrams, photographs used

2 = moderate = a reasonable number of visuals used, but more needed

3 = good = a good mix of text and visuals

Language - Number of languages which the manual is available in - 1 point = 1 language etc

Structure = 1 point awarded each for the existence of contents, foreword, introduction, page numbers, index, references, bibliography, numbered headings, List of tables/ figures, easy of use.

Structure = ?/10

Scope of then manual: Yes = 3 Some = 2 Little = 1 No = 0

(under maintenance, and construction: 1 point each for B(ridge), R(oad) and D(rainage)).

Where a specific manual is being prepared for an individual organisation, the first task is to secure institutional and management support for the whole principal and need of the manual. Donor organisations in particular should ensure that there is clear management commitment to the production of manuals which may be part of an aid package.

Management commitment must also be shown to be sustainable. Managers may be sincere in their support, but in reality the organisation must be understood and evaluated. A number of key questions should be asked:

- What quality of support systems exist in the organisation? e.g.: financial, accountancy, budget processes, computers, data collection etc.
- Will the manual be compatible to the existing systems or will change or modification be required?
- Are the necessary personnel skills and financial resources available to ensure continued operation and maintenance?
- What training facilities exist or are available? Will proper training and support be offered?
- Will the outcome of the manual impact on other institutional policies? e.g.; employment, policy, wages, labour based methods etc.

3.4. Purpose and Status

The purpose of the manual should be agreed with senior managers. Some manuals may be required to record existing systems whilst others are to form the basis for new systems. The status of the manual within the organisation should also be agreed. Is it an advisory manual to be used with discretion or a mandatory manual requiring absolute compliance? Which members of staff will have authority to exercise discretion? How will the use of the manual be monitored?

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Report II - Appendix I Assessment of Maintenance Manuals

Appropriate and Efficient Maintenance of Low Cost Rural Roads

Report II - Appendix I Assessment of Maintenance Manuals

February 2000

The University of Nottingham
School of Civil Engineering
University Park
Nottingham
NG7 2RD
United Kingdom
www.nottingham.ac.uk/p&g

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321 Millbrook Road West
Southampton
SO15 0HW
United Kingdom
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School of Civil Engineering
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94 Victoria Street
London
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APPENDIX TO REPORT II - ASSESSMENT OF MAINTENANCE MANUALS

1. THE MANUALS

The manuals were assessed against criteria (as summarised and put forward in the main report). The following report is a summary of the findings and gives details relating to each manual assessed. The criteria used for assessment of the manuals may be summarised as follows:

Component to be assessed	Choices to be considered
User related issues	
Who is the document aimed at?	Lengthman/ Engineer etc.
Are the more complex tasks satisfactorily defined?	Perhaps using pictures/ visualise.
If the document is aimed at a particular user, is it suitable?	Sturdy & suitable for the user.
Is the manual written with the user in mind, ie: does it state it anywhere.	

Aesthetics of manual

Component to be assessed	Notes/ general comments
The Manual	
Size of the manual	Pocket size, A5, A4, A3 or larger?
Colour of manual	
Type of manual	Hard/ paperback/ loose-leaf in folder/cards
Number of pages	
Number of Chapters	
Size of text	Small or large
Type of text	Font (Size and type)
The visual aids	
Number of Photographs	Per chapter and total number in manual
Quality of Photographs	Poor/ Fair/ Good (refers to image quality)
Type of Photographs	Black & White or Colour photograph
Number of Tables	Per chapter and total number in manual
Quality of Tables	Poor/ Fair/ Good (refers to image quality)
Number of Diagrams	Per chapter and total number in manual
Quality of Diagrams	Poor/ Fair/ Good (refers to image quality)
Number of Graphs	Per chapter and total number in manual
Quality of Graphs	Poor/ Fair/ Good (refers to image quality)
Is annotation used?	In photographs, tables, diagrams and graphs to describe the image..

General information

Component to be assessed	Choices to be considered
Author specific	
Number of Authors	
Manual written by....	Names of Authors
Publisher specific	
Publisher	
Date Published	
ISBN	If applicable
General	
Number of editions	
Date of revisions	

Structure of the manual

Component to be assessed	Choices to be considered
Structure/ layout	
Is there a contents page?	Is it easy to understand
Is there a 'Foreword'?	Length/ Is it sufficient
Is there an 'Introduction'?	Length/ Is it sufficient
Are visuals numbered?	Photographs, tables etc.
Is there a list of photographs?	
Is there a list of tables?	
Is there a list of diagrams?	
Is there a list of graphs?	
Is there a list of abbreviations?	If abbreviations are used
Length of Chapters	Too long/ Too short
Are page numbers used?	
Is there an Index?	Is it easy to use
Is there an additional list of information given?	Addresses of organisations.
Are the references listed?	Is it easy to use/ understand
Is there a Bibliography?	Is it easy to use/ understand
Blank forms provided for copying?	
Is there space for notes?	
Language	
Is the manual available in other languages apart from English?	List them
Quality of the manual	
Quality of Photograph	Poor/ Fair/ Good (ease of understanding)
Quality of Tables	Poor/ Fair/ Good (ease of understanding)
Quality of Diagrams	Poor/ Fair/ Good (ease of understanding)
Quality of Graphs	Poor/ Fair/ Good (ease of understanding)
General	
Is the document easy to understand?	
Did the information flow?	Or was it rather disjointed.
Are complex tasks adequately defined, for the proposed audience?	
Does each section contain a sufficient number of visuals?	To adequately portray info.
Are training aids available?	Such as videos.
Rating of manual's layout etc.	
The overall 'feel' of the manual?	Did it give a good impression.
The ease of use of the manual?	Easy to find out information.
Was it an interesting read?	Did it 'hold' the reader.
Was it long winded and rhetorical?	Or simple and easy to read.
Were there any outstanding items?	Information which was unusual and interesting.

Scope of manual

Component to be assessed	Choices to be considered
Scope of manual	
Does it cover Maintenance?	Pavements/ Structures etc.
Does it cover Construction?	Pavements/ Structures etc.
Aspects of maintenance covered in the manual	Methods expected are detailed in IRMH series 1 to 4 (as a guide)
Pavements (paved)	Bituminous/concrete
Pavements (unpaved)	Earth/ Gravel
Gravel road maintenance	Methods
Shoulder maintenance	Methods
Drainage maintenance	Methods
Maintenance of structures	Bridges and Culverts
Material related issues	Types/ specifications/ sources
Equipment related issues	Types/ maintenance of equipment
Workforce	Numbers required
Training	Type needed/ given by etc.
Other aspects covered	
Traffic Management	Signs/ Roadmarkings/ Furniture
Safety aspects	Workforce and road users
Winter maintenance measures	
General	
Inventory	Requirements/ setting up
Programming of maintenance	How to do it/ how to maintain a system
Sample worksheets/ forms	
Does the text contain any information that could go out of date quickly?	Prices of labour/ equipment/ materials.
Does the manual use depiction of defects?	Using photographs or diagrams rather than written explanations.
Are the depictions effective?	Easy to understand the message.

Table 1 lists the manuals gathered and those assessed (as indicated by **bold type**):

Country	Author/ Organisation	Title of Manual or relevant publication
Australia	ARRB	Sealed Roads Manual
Australia	ARRB	Unsealed Roads Manual
Australia	Giummarra	Guidelines to good practice for the construction, maintenance and rehabilitation of pavements.
1. Benin	Scott Wilson Kirkpatrick	La Brigade Legere
Botswana	Republic of Botswana	Technical Manual - District Road Unit.
Botswana	Republic of Botswana	Maintenance Training Manual
Botswana	Johansen, R	Management and supervision of labour based road construction and management.
Cambodia	Johannessen	Field manual for labour based road supervisors.
2. Ghana	COWI Consult	Maintenance performance budgeting system.
Indonesia	Beusch, Hartman et al	Low cost road construction in Indonesia Volume 1
Indonesia	Beusch, Hartman et al	Low cost road construction in Indonesia Volume 2
Indonesia	Government of Indonesia	Technical manual for implementation of routine road management using labour intensive methodology.
Kenya	Petts	Minor Roads Programme Vol 1 - Technical Manual.
Kenya	Petts	Minor Roads Programme Vol 2 - Maintenance Manual.
Kenya	Petts, Beusch	Roads 2000 works manual.
3. Kenya	Republic of Kenya	Road maintenance manual Part 1 - Induction course for overseer trainees.
4. Kenya	Republic of Kenya	Road maintenance manual Part 2 - Overseer course.
5. Kenya	Republic of Kenya	Road maintenance manual Part 3 - Overseer 1 course.
6. Kenya	Republic of Kenya	Road maintenance manual Part 4 - Foremans course.
7. Kenya	Waichanguru	Maintenance Inspectors Manual.
8. Kenya	Waichanguru	Maintenance Overseers Manual.
9. Laos	Marks	Maintenance management manual.
10. Laos	RFRM training project	Field manual - labour based rural feeder road maintenance
Lesotho	SIDA/ IT Transport	Technical Manual.
11. Malawi	Scott Wilson Kirkpatrick	Foremans site manual.

Malaysia	Jalan, Cawangan	JKR - Guideline for the management of road maintenance contracts. 1997
Malaysia	Jalan, Cawangan	JKR - Standard specification for routine maintenance of roads and structures by contract. 1997
12. Nepal	His Majesty's Government of Nepal & ODA	Vegetation structures for stabilising highway slopes - A manual for Nepal
13. Nepal Mountainous countries	TRRL	Overseas Road Note 16 - Principles of low cost road engineering in mountainous regions.
14. Papua New Guinea	Government/ Roughtons	A series of 8 road maintenance field manuals
15. South Africa	Natal Roads Department	Betterment and gravelling manual.
South Africa	Committee of State Road Auth	TRH 17 - Geometric design of rural roads
South Africa	Committee of State Road Auth	TRH 18 - The investigation, design, construction and maintenance of road cuttings.
16. South Africa	Committee of State Road Auth	TRH 20 - The structural design, construction and maintenance of unpaved roads.
Tanzania	ILO/ Intech	Appropriate Technology, Labour-based roadworks technical manual - Volume 1 Road Rehabilitation Works.
Tanzania	ILO/ Intech	Appropriate Technology, Labour-based roadworks technical manual - Volume 2 Road Maintenance.
17. Tanzania	Selvarasa, K	Manual on improvements/ maintenance of paths. Makete integrated rural transport project.
18. Tanzania	Saetrum	Hanna Nassif - Community Development Project - Manual on maintenance and drainage of roads.
19. Uganda	MoWTC	Road maintenance management guidelines
20. Uganda	MoWTC	DRAFT Maintenance manual
Zimbabwe	Department of State Roads.	Field manual for labour based road construction
21. Any country	Overseas Unit TRL	Overseas Road Notes 1
22. Any country	Overseas Unit TRL	Overseas Road Notes 2
23. Any country	PIARC	International Road Maintenance Handbook (IRMH) - Volume II (Maintenance of unpaved roads)
24. Any country	United Nations Economic Commission for Africa	Road Maintenance Handbook - Volume II (Maintenance of unpaved roads)
25. Any country	Overseas Centre TRL	Overseas Road Note 15: Guidelines for design and operation of road management systems
26. Fiji	Public Works Department	A variety of manuals relating to maintenance

Table 1 - Manuals assessed

2. LA BRIGADE LEGERE - SCOTT WILSON KIRKPATRICK – BENIN

Unfortunately it was not possible to review this manual properly as it is written only in French. The fact it has been written only in the local language is of course a positive step. The manual looks interesting and is written in a style that uses lots of sketches and diagrams to help put across the point. The manual is not available in English at all. However it covers the following subject areas:

- La mobilisation - mobilization, to move
- La brigade en pleine production - workforce(?) in full production
- La mise en forme - taking shape(?)
- La carriere - sandpit/quarry Le rechargement - reloading/refilling
- La gestion d'une brigade legere - the management of a light workforce
- Le bureau - the office
- Le chef de brigade - foreman/supervisor(?)
- Sauvegarder l'investissements - to safeguard the investments
- Les Ouvrages - the works
- Entretien de pistes - track/trail maintenance
- Entretien mecanique - engine/mechanical maintenance
- Considerer l'avenir - to think about/consider the future
- la planification - The planning/schedule
- La sante et securitie - health and safety

3. MAINTENANCE PERFORMANCE BUDGETING SYSTEM - COWI CONSULT – GHANA

3.1. General Information

The manual is produced by the Republic of Ghana, Ministry of Roads and Highways, Department of Feeder Roads & the Ministry of Foreign Affairs, Danida in 1994. The manual states that the report is one of several produced as part of a larger study. The introduction explains that the MPBS was developed by the Department of Feeder Roads as part of a National Feeder Roads Rehabilitation and Maintenance Project (NFRMP).

3.2. Proposed audience

The proposed audience is an engineer within the 'Regional Engineer's maintenance organisational structure, although sections of the manual will guide and aid the Road Foreman in the execution of their duties'¹. The manual does not however try to fulfil the need for a manual specifically for Road Foremen, which may be why it relies less on visuals than text to get the point across. The manual is based on a mix of text, tables and some diagrams. The document is a photocopy of the original provided by ASIST.

3.3. Aesthetics of manual

The manual is A4 in size. The manual has over 100 numbered pages, with a number of appendices. The manual has 11 sections (chapters), which are listed at the front of the document in the 'Table of Contents', together with a Foreword and 'Appendices'. The text is small and the font is serifed.

The quantity of visuals to text is very low, however, use is made of tables. At first glance, the manual contains a lot of very specific information, is not of a pocket format and is the type of document which would be perhaps part of an engineer's library, rather than a manual which would be used on a daily basis. It does state in the foreword that the manual could be used as part of a training course, if that were the case it would have to be backed up with visuals and practical examples. The aesthetics could be improved by the addition of photographs and diagrams to break up the text.

3.4. Structure of manual

The manual contains a 'Contents' with page numbers, 'List of Appendices', 'Summary of MPBS report', 'Foreword', and 'Introduction'. Blank forms are provided in the appendices, which could easily be photocopied. The manual is easy to follow, as the contents page is detailed. The manual does not contain an index and the large number of appendices can make it difficult to find the desired piece of information.

3.5. Scope of manual

The manual is split into the following sections:

Introduction

Responsibilities and duties

Field surveys

Maintenance requirements

Annual maintenance work programme and performance budget

Performance standards

Safety instructions

Methods of undertaking maintenance

Work scheduling

Reporting

Control and monitoring of works

¹ Maintenance performance budgeting system, COWI Consult – Ghana, 1994, p4.

List of Appendices: Survey Forms; Work planning forms; Activity specifications; Standard contract document; Work scheduling forms; Work control and monitoring forms.

3.5.1. Introduction

Purpose and scope of the MPBS. Definition of performance budgeting, defining the main elements as: work activities, the road inventory, quantity standards and work programmes and performance budgets. Useful MPBS flow chart to demonstrate the stages of the system. The Activity List in the form of a table lists all the activities, work units, inventory units and quantity standard units under separate group headings of: Surface Maintenance; Drainage Maintenance; Roadside Maintenance; Structure Maintenance; Transport of Materials and Minor Rehabilitation Works. A section on maintenance policies states the difference between and the need for general policies, specific policies and detailed policies and then sets out a list of policy statements which relate directly to the MPBS. Finally the introduction gives a definition of terms and abbreviations.

3.5.2. Responsibilities and Duties

Management tasks – the roles of various management levels are defined (HQ, Regional management, Road area management). The management duties are specified for Head Office, Regional Engineer, Regional Maintenance Engineer, Road Area Engineers and the Road Foreman. Approximately half a page of bulleted points for each level of staff is listed and could be used as a broad base job description. Organisation is covered separately and is accompanied by a organisational chart of Regional Engineer down to Foreman level. It states that: 'During the duration of the present consultancy project the Deputy Director will be assisted by a counterpart expatriate Road Maintenance Engineer. To carry out the main functions of the HQ there will be a Planning and Monitoring Unit and an Administration section, responsible to the Deputy Director'². (This indicates that the changes implemented required back up to be provided to the department from the consultant. Action, timing and responsibility are dealt with and backed up by a chart to demonstrate the process of implementing the MPBS from the initial preparation of the inventory to the approval of funds and the scheduling of maintenance.

3.5.3. Field surveys

Explains the field surveys which must be undertaken to ensure the MPBS is meaningful. The field surveys should include a physical road feature inventory and a classified traffic count, and maintenance of those roads included in the programme. The manual specifies that a road code reference system is an essential prerequisite for the surveys. Road and drainage structure inventories, for the purpose of the MPBS it is specified that it should contain: type of road surface, number of culverts and bridges and traffic volume. Other items which are also useful, such as terrain conditions and soil condition are also listed as desirable for analysis of maintenance needs. Examples of the different inventory forms are given, (filled in), to demonstrate the type of information required. Condition surveys and the procedures to be used are based on the World Bank methodology and the Organisation for Economic Co-operation and Development, 1990. However, it states that to define the maintenance needs with 'reasonable' accuracy, a slightly more detailed approach was adopted. The distress types which should be considered are stated as:

Potholes, corrugations, rutting, gullies in carriageway, loss of camber, slippery of rocky carriageway, debris and vegetation encroachment, siltation of side ditches and turnouts, scour of side ditches and turnouts.

A brief description of each is then given, but diagrams or photographs are not used, but could feasibly have helped. The rating system is established and described, for example: Rating 1 = 'very good; no defects, routine maintenance only required'. Again, photographs could have been used to back up the text. A completed survey form is used to demonstrate the system. Severity ratings of: Light, Moderate and Severe are also introduced and are specified for each of the distress types. For example:

² Maintenance performance budgeting system, COWI Consult – Ghana, 1994, p32.

Rutting				
	Severity		Extent	
Type	Average depth	<10%	10 – 50%	>50%
Light	<25mm	1	2	5
Moderate	25 – 75mm	2	4	6
Severe	>75mm	3	5	7

Table 2 - Severity ratings

The system seems to be very thorough, if a little complex for someone to learn from scratch. The rating system for bridges and culverts is on a 5 point rating scale, which is slightly different to that used for the roads.

3.5.4. Maintenance requirements

The manual states that the main factors which contribute to road deterioration are traffic and climatic factors. In particular it mentions rainfall zones, and rainfall data as been used to split Ghana into 4 rainfall zones. Appropriate levels of maintenance are discussed and the fact that whole life costing should be considered. The manual states that maintenance intervention levels should be chosen which are optimum from an economic standpoint. Annual quantity standards are used for the four rainfall zones, together with 7 traffic classes. The annual quantity standards are then divided into 'basic quantity standards' – 'the quantity for each single maintenance intervention for the various maintenance activities and 'frequency standards' – the number of times the various maintenance activities are planned to be undertaken each year³. Basic quantity standard X Frequency standard = annual quantity standard. Ideal or optimal basic quantity and frequency standards are given in a table, although it states that modifications may be necessary once more experience is gained. The importance of work unit measurement is specified and it is stated that the road foreman should measure the work in the presence of the contractor, with a standard form being signed by both parties. Standard units of measurement for each activity are given.

3.5.5. Annual maintenance work programme/ performance budget

Basic labour costs in Ghana are not negotiable but the quantity of labour in each standard activity of maintenance work is. The method of calculating the standard work unit costs are defined and a form to undertake the calculations is provided. The annual work programme and performance budget is calculated to fit an ideal situation and then adjusted to fit in with the budget allocation received. A computer program based on Excel is used to prepare the national annual work programme. A flowchart indicating the MPBS computer program is given. The feeder roads maintenance budget for each activity for 1994 is given for each region, together with maintenance works, quantities and budgets for one region, and quantity of each type of work to be carried out on a particular road.

3.5.6. Performance standards

This section specifies what an activity specification should include: official name and number; description and purpose of the activity; performance and scheduling considerations; typical crew size and composition; approved equipment to be used; approved materials to be used; approved work method; brief technical specification; method of measurement of work. The descriptions are very brief, but a full and detailed specification for each activity is given in the appendix.

3.5.7. Safety instructions

Specifies the use of signs and barriers and safety measures to be taken. A small number of traffic control layouts, similar to Chapter 8 signing are given.

³ Maintenance performance budgeting system, COWI Consult – Ghana, 1994, p57/58.

3.5.8. Methods of undertaking maintenance

Labour based methods are encouraged and a table detailing whether each activity can be practically completed by labour based or equipment based methods is detailed. Force account and contract – the effectiveness of force account work has generally declined, and the use of contractors can be more effective. The section stresses that even though it has been accepted that contracting is more appropriate, there are certain conditions which have to be met, such as: prompt and regular payment of contractors, high quality site supervision, increased surveillance and monitoring, training for new contractors. 'Contract maintenance is ideally suited to performance budgeting since expenditure is directly related to work accomplished'⁴. The section also talks of using the existing grader team. 'Whereas the contractor will not be paid for sub-standard work, the force account graders will be instructed to repeat unacceptable work'⁵. The section goes on to talk about the types of contract and contractor to be used and the contract document.

3.5.9. Work scheduling

Annual and monthly scheduling is necessary to ensure the targets are accomplished. Guidelines on annual distribution of activities and resources are given in the appendix. Consideration is given to the seasonal factors and the actual maintenance needs to be addressed. The monthly work scheduling procedures are specified as follows: Identification of maintenance needs; preparation of draft schedules; schedules to be adjusted and approved by the regional engineer and the issuing of works instructions. With regard to the identification of maintenance needs, the section states that it is the responsibility of the Road Foreman to inspect the roads included in the programme, once per month, and assign a priority of 1, 2 or 3 to the defect. This task (during the second week of the month) is followed by the preparation of draft schedules. Some activities such as grass cutting and ditch cleaning can be planned months in advance. Other activities have to be assigned as a priority depending on the actual maintenance need. Grader maintenance can often dictate when other routine activities should take place. Monthly scheduling meetings chaired by the Regional Engineer ensure that the network as a whole is controlled and monitored. The issuing of the work to the contractor is undertaken using a selection of standard forms, filled in by the road foreman. A filled in annual regional/ road area labour force schedule form, a annual regional/ road area critical equipment schedule an annual regional/ road area work quantity schedule are given.

3.5.10. Reporting

It states the base document for the MPBS is the payment certificate for individual contracts. There are different levels of reporting required at different levels within the organisation. Six different types of report form are detailed – purpose etc. A flow chart detailing the reporting procedure is detailed. The procedure seems rather complex due to the number of forms specified. Examples are filled in forms are given.

3.5.11. Control and monitoring of works

Operational control procedures are detailed, together with the duty and responsibility of each member of staff. System control, directing functions and quality control are also detailed.

3.5.12. Appendix

Blank survey forms, Blank work planning forms, Activity specification sheets for all activities – information included:

- Description and purpose
- Performance and scheduling considerations
- Typical crew required
- Approved equipment
- Approved work method

⁴ Maintenance performance budgeting system, COWI Consult – Ghana, 1994, p79.

⁵ Maintenance performance budgeting system, COWI Consult – Ghana, 1994, p80.

- Approved material
- Technical specification
- Method of measurement of work
- Standard contract documentation
- Work scheduling forms
- Work control and monitoring forms

3.5.13. General observations

The manual gives a lot of detailed information regarding what is required for the system. It is very specific to the Ghana situation and what is required for the MPBS, however some of the information could easily be regarded as generic. In particular the activity specifications are useful and would be effective as a reference document in its own right. There are insufficient diagrams used, but that may be due to the intended audience and the fact that it was felt that diagrams would be surplus to requirement. Photographs of defects would have aided the reader in understanding the different levels of deterioration to be investigated as part of the condition assessment. In conclusion, as a manual, it is very specific and therefore does not cover everything that may be desirable in a maintenance manual, however, it does cover many areas which would be desirable and much of the information is probably not so specific as to make it useless when removed from the environment in which it was intended to be used.

This manual is a “this is what you should do and here is how to do it” type of manual.

4. ROAD MAINTENANCE MANUAL PART 1 - INDUCTION COURSE FOR OVERSEER TRAINEES. REPUBLIC OF KENYA

4.1. General Information

The manual is produced by the Republic of Kenya, the Government of Switzerland and Helvetas. The manual is dated 1986. A most surprising aspect of the manuals, is why certain topics have been placed together in each of the booklets. There seems to be little obvious reason for placing certain subjects together in the same book. Although it may be due to the way the accompanying training is carried out.

4.2. Proposed audience

The preface states that the four books together have been written specifically for the needs of Kenya, and are intended for training purposes. The title of the manual indicates that the audience is an Overseer.

4.3. Aesthetics of manual

The manual is A5 in size, and has coloured cardboard covers. The manual has just over 60 pages, which are numbered. The manual is in black and white, with diagrams, photographs, sketches and tables etc. The text is bold and the font is un-serifed.

At first glance the manual is reminiscent of a school work book, as it contains useful examples of calculations and uses diagrams to good effect.

4.4. Structure of manual

The document is well laid out, with a 'Preface', 'Contents' page with page numbers, and an 'Introduction'.

4.5. Scope of manual

The contents of the manual are as follows:

Introduction

Mensuration (Definition of units of measurement).

Road drainage

Shoulder and slope maintenance

Road signs maintenance

4.5.1. Introduction

The Introduction gives a number of definitions of terms, such as Routine, Periodic and Urgent maintenance. It is written in a similar style to the PIARC handbooks. The purposes of road maintenance are then covered and an example of the cost savings made by proper maintenance based on 1980 prices are given. The three purposes of road maintenance are given as: reducing the deterioration of the road to prolong life, to lower vehicle operating costs and to keep the road open. The significance of road maintenance in Kenya is then covered and a definition of an unpaved and paved road is depicted in a diagram, together with the structural elements of a flexible carriageway.

4.5.2. Mensuration (Definition of units of measurement).

This part of the manual simply deals with simple mathematics such as calculating areas and volumes, the relationship between volume, weight and capacity, also temperature, speed, slope are covered. More importantly, a section on rates gives examples of calculating man-days and calculating quantities.

4.5.3. Road drainage

Photographs, diagrams and tables are used to good effect to explain the possible problems encountered with regard to road drainage. Different types of drain are depicted, together with the camber and how to measure it. The specified % of camber for different types of road is given. Types of side drains are depicted, together with scour checks. Standard details for different types of scour check are given. Standard details for mitre drains are provided. Culvert sizes and sections are provided. Sufficient information is given to allow someone who has no experience of road drainage to get a good grasp of the subject and attempt to oversee a contractor or gang of labourers. Drainage maintenance is then covered, after the construction of good drainage has been completed. The purpose of maintenance is simply specified as:

‘To drain off effectively the surface water and to drain ground water’.

Inspection, defects and maintenance criteria is then covered in some detail, the overseers responsibilities are specified. A set of tables then specifies the defects, causes and required maintenance activity for ditches and drains, culverts, fords and causeways. The execution method for various maintenance activities is then given, and includes the resources required, the method of measurement, the average daily accomplishment and the work method. Diagrams are supplied where necessary. The information given could possibly have been more effectively presented in the form of an activity sheet, but as it is part of the main manual rather than an appendix, it is perfectly adequate.

4.5.4. Shoulder and slope maintenance

A definition of shoulders and slopes, together with the purpose is given. Then in the same format as the section on drainage, the inspection, defects and maintenance criteria and activities are detailed. Again, diagrams are used to good effect.

4.5.5. Road signs maintenance

A definition of the signs is given. Then in the same format as the section on drainage, the inspection, defects and maintenance criteria and activities are detailed.

4.5.6. General observations

The manual contains information which relates specifically to routine maintenance. It demonstrates to the reader why the elements of the road etc are there, what they are made up from, the possible defects and the methods of repair and maintenance. The manual is simplistic in the same way as the PIARC manuals. The manual provides useful information on mensuration, such as one might find in a simple mathematics formula book. There is a good mix of photographs, diagrams and tables. The manual does not cover any planning, programming or recurrent maintenance activities, but as there are four books in the series, such information may be contained in the other books.

This manual is a “this is what you should do and here is how to do it” type of manual.

5. ROAD MAINTENANCE MANUAL PART 2 - OVERSEER COURSE. REPUBLIC OF KENYA**5.1. General Information**

The manual is produced by the Republic of Kenya, the Government of Switzerland and Helvetas. The manual is dated 1986.

5.2. Proposed audience

The preface states that the four books together have been written specifically for the needs of Kenya, and are intended for training purposes. The title of the manual indicates that the audience is an Overseer.

5.3. Aesthetics of manual

The manual is A5 in size, and has coloured cardboard covers. The manual has just over 90 pages, which are numbered. The manual is in black and white, with diagrams, photographs, sketches and tables etc. The text is bold and the font is un-serifed.

At first glance the manual is reminiscent of a school work book, as it contains useful examples of calculations and uses diagrams to good effect.

5.4. Structure of manual

The document is well laid out, with a 'Preface', 'Contents' page with page numbers, there is no introduction, as it is contained in the first book of the series.

5.5. Scope of manual

The contents of the manual are as follows:

Maintenance of paved roads

- Tack-coat, prime coat and seal coat
- Premix
- Patching filling material
- Patching
- Edge repair
- Spot sealing
- Crack sealing

Concrete technology

- Materials
- Manufacturing concrete
- Placing concrete
- Compacting
- Curing
- Factors influencing the quality of concrete
- Tilting concrete mixer

Masonry

- Mortar
- Stones and concrete blocks
- Manufacturing mortar
- Concrete block walls, brickwalls
- Stonework

Making and laying culverts

- Making culvert pipes
- Laying culvert
- Construction of inlet and outlet

Safety measures and traffic control

Standard signs

Principles

Temporary sign posting

Stores keeping

Stores general

Preservation of stores

Losses of stores

Handing over

Stores documents

Main procedures

The Supervisor

5.5.1. Bitumen technology

Theory of bitumen technology put forward to ensure overseers and foremen are able to undertake pothole patching effectively. Includes description of bitumen and different types of bitumen. Explanation of penetration and viscosity, classification of bitumen and the characteristics of the different types. Then moves on to tack coat, prime coat and seal coat, giving definitions, mix proportions, batching, and mixing. Patching filling materials, looks at the quality of the material, stabilisation and then how to patch using the material using diagrams and photographs to explain the procedure. Resources and output are also covered. Edge repair and crack sealing is covered in the same detail.

5.5.2. Concrete technology

The materials required are defined, and issues such as impurities and storage are covered. The method of manufacture of concrete is then covered, with quantities and mixing methods being given. Placing, compacting and curing of the concrete is then covered, but testing is not. The information given is of sufficient detail and is easy to follow. The section even discusses the maintenance of a concrete mixer.

5.5.3. Masonry

In a similar way to the section on concrete, definitions are given, together with an explanation of the manufacturing process. Attention is paid to joints made with mortar in foundations. The same amount of information is also applied to the subject of small stonework walls.

5.5.4. Making and laying culverts

The reader is reminded of the definition and description of a culvert as given in book 1. The manual then explains how to manufacture culvert pipes, then how to lay them, align them and level them. The explanation includes preparation of the trench and backfilling. An example of the calculations required when installing a culvert under an earth road are given. Construction of the inlet and outlet are also covered in some detail. The section uses diagrams and photographs to good effect and is comprehensive.

5.5.5. Safety measures and traffic control

Diagrams of standard signs are given, including a guide to sign dimensions. The section gives some useful alternatives to using signs and barriers, for use when the signs themselves may not be freely available. Operation of STOP/GO boards are given. Emphasis is given to removing signs when men are not working. Temporary signposting for different types of work on the road is explained. For situations such as: edge working, lane closure and diversions, including traffic management layouts for the different situations.

5.5.6. Store keeping

A definition of stores and the difference between unallocated and allocated stores is provided. The different categories of stores: permanent, consumable and expendable are defined. The requirements for a store building are provided, together with the layout of the

store and the preservation. A specimen handing over certificate is given, for the situation when an overseer or foreman is transferred. Stores documents are introduced and examples given, which have been generally filled in. The documents are not presented in a form which could be photocopied. Ordering and receiving and transferring stores items from district HQ is covered in great detail, with flow charts and examples of the documents taking up some 20 pages.

5.5.7. The Supervisor

This section deals with what is expected of someone in a supervisory position. Ideal characteristics of someone filling a supervisory position are given. There are also a few paragraphs given on planning work, using authority and passing on information and getting results from the efforts of others. The information given is sound, although it would perhaps be better as part of a separate document dealing solely with staff relations, rather than contained in a manual which predominately deals with practices relating to maintenance and construction.

5.5.8. General observations

The manual contains useful and important information relating to concrete, bitumen etc. The information would probably be of interest to a variety of staff members, from those supervising the work, to those undertaking it. Some of the information given is sometimes more complex than expected, but this may be as the topics being covered are very specific to Kenya and therefore of great importance to the reader. For example: Classes of bitumen emulsion are covered with their characteristics and the factories which produce them. Such information is beyond that covered in the PIARC handbooks. Yet, in general the manual is simplistic. There is a good mix of photographs, diagrams and tables. The section on stores is quite detailed, indicating that it is felt to be a very important part of the job.

This manual is a “this is what you should do and here is how to do it” type of manual.

6. ROAD MAINTENANCE MANUAL PART 3 - OVERSEER 1 COURSE REPUBLIC OF KENYA

6.1. General Information

The manual is produced by the Republic of Kenya, the Government of Switzerland and Helvetas. The manual is dated 1986.

6.2. Proposed audience

The preface states that the four books together have been written specifically for the needs of Kenya, and are intended for training purposes. The title of the manual indicates that the audience is an Overseer. Surprisingly and without explanation, Part 3 (Overseer I) comes after Part 2 (Overseer II).

6.3. Aesthetics of manual

The manual is A5 in size, and has coloured cardboard covers. The manual has just over 100 pages, which are numbered. The manual is in black and white, with diagrams, photographs, sketches and tables etc. The text is bold and the font is un-serifed.

At first glance the manual is reminiscent of a school work book, as it contains useful examples of calculations and uses diagrams to good effect.

6.4. Structure of manual

The document is well laid out, with a 'Preface', 'Contents' page with page numbers, there is no introduction in this particular book, as it is contained in the first book of the series.

6.5. Scope of manual

The contents of the manual are as follows:

- Personnel matters
- Administrative matters
- Roads maintenance camp sanitation
- Soil Mechanics
- Grading
- Plant operating and maintenance

6.5.1. Personnel matters

A description of the Ministry of Transport and Communications is given, with organisational charts. An explanation of the officers within the districts is given and perhaps goes some way to explaining the way the manuals are set up. An Overseer trainee is an apprentice in the field attached to an Overseer I or a Foreman. An Overseer I is in charge of a small camp, responsible to the Officer in charge of the division. The Overseer II is the assistant to the officer in charge of a roads maintenance camp. It goes on to state that 'A foreman is usually the officer in charge of a camp where responsibilities are greater. Therefore he has greater but similar responsibilities to an OSI, as generally he is expected to supervise the OSI attached to camps within his area'⁶. Basically it is all rather confusing, and the same name appears to apply to a number of different people! The roles of the Inspector of Roads, District Engineer and Provincial Engineer are also covered. Terms of employment briefly cover issues such as permanent staff with and without pension benefits. Rules of conduct covers the type of information one might expect to find in an employee's handbook. Salaries, leave, housing and allowances are also covered, and again they would perhaps be better covered in an employee's handbook.

6.5.2. Administrative matters

Covers monthly and weekly administrative duties which are the responsibility of the overseer/foreman. The use of government vehicles is covered in some detail and an example of a

⁶ Road maintenance manual Part 3 - Overseer 1 course, Republic of Kenya, 1986, p4.

filled in work ticket it provided. Vouchers, and what should be filled in are also covered. The muster roll and a daily work report, pay rolls, monthly log sheets are covered in some detail, with examples given of how to fill in the forms.

6.5.3. Roads maintenance camp sanitation

The health and welfare of the staff at the camp is dealt with. Choice of the site for a roads maintenance camp and the arrangement of the camp, including construction of staff houses, and the construction of latrines, (covered in great detail).

6.5.4. Soil Mechanics

Soil classification is dealt with in a simple way and a simple table of characteristics of cobbles, gravels, sands, silts and clay is provided. The identification of soils is covered using a flowchart, and a number of very simple classification tests are detailed. The suitability of soil for road maintenance is briefly mentioned and a table of the characteristics of soils pertinent to roads is provided. The soil types commonly found in Kenya are detailed. Compaction of soils for road maintenance purposes is detailed, with rules concerning the choice and compaction of soils being given. Types of compacting equipment is detailed and advice is given on the choice of roller to be used. A detailed table lists the average outputs of plant and costs per cubic metre of compacted soil.

6.5.5. Grading

The manual states that grading is the most important operation in the maintenance of earth and gravel roads. A chart specifies the frequency of grading for different classes of road. The general principles of grading are given. Mechanical ditch cleaning using a grader to maintain V-shaped ditches is defined and diagrams demonstrate the procedure. The task of light grading and heavy grading is defined and methods for executing the work are given. Light and heavy grading of unpaved shoulders is covered.

6.5.6. Plant operating and maintenance

The plant which is normally found at a maintenance camps is detailed and then the works which can be carried out with each piece of equipment is specified. The principles of grading are also covered. The basics of starting and stopping heavy machinery and the maintenance of plant and vehicles is also very detailed. In particular, a number of pages depict the maintenance procedures to be adopted by the maintenance of graders and similar sized pieces of equipment. A number of pages give a checklist for heavy plant and other vehicles. Safety issues relating to vehicles and machinery are covered, using comical sketches.

6.5.7. Appendix

The manual finishes with a list of equipment codes, material codes and a work activity catalogue which gives the unit of measure to be used.

6.5.8. General observations

The manual leaves the reader thinking that someone accidentally put all the subject matters together, as they really don't seem to belong in the same book. It becomes apparent after looking at all of the manuals that the contents needs to be redistributed, so that similar subjects actually appear in each book. However, it may just be that each level of personnel need different types of information.

This manual is a "this is what you should do and here is how to do it" type of manual.

7. ROAD MAINTENANCE MANUAL PART 4 - FOREMANS COURSE. REPUBLIC OF KENYA

7.1. General Information

The manual is produced by the Republic of Kenya, the Government of Switzerland and Helvetas. The manual is dated 1986.

7.2. Proposed audience

The preface states that the four books together have been written specifically for the needs of Kenya, and are intended for training purposes. The title of the manual indicates that the audience is a Foreman. Aesthetics of manual

The manual is A5 in size, and has coloured cardboard covers. The manual has just over 60 pages, which are numbered. The manual is in black and white, with diagrams, photographs, sketches and tables etc. The text is bold and the font is un-serifed.

At first glance the manual is reminiscent of a school work book, as it contains useful examples of calculations and uses diagrams to good effect.

7.3. Structure of manual

The document is well laid out, with a 'Preface', 'Contents' page with page numbers, there is no introduction in this particular book, as it is contained in the first book of the series.

7.4. Scope of manual

The contents of the manual are as follows:

- Regravelling
- Introduction to resealing
- Bridge maintenance
- Roads maintenance management

7.4.1. Regravelling

A short discussion on gravel is undertaken and then the tasks necessary when opening a new gravel pit. The execution of the regravelling process is then covered, from tipping the gravel to compacting it. A section on regravelling calculations gives an example of how to calculate volume of gravel required, in the loose and compacted form. Loader and dozer operating techniques are covered, using amusing sketches to illustrate various points.

7.4.2. Introduction to resealing

A definition of resealing is given and followed by detailed of the surface preparation required. Materials – aggregate and binder are then covered. A description of the bitumen distributor is given together with a short description of some of the other type of machinery. The operation of resealing a road is detailed in a step by step manner. The traffic signs required are also mentioned.

7.4.3. Bridge maintenance

The definition of a bridge and the objective of maintaining it are detailed. A short description of reinforced concrete bridges, timber and steel bridges is provided. Inspection is broadly discussed, together with the supervisors responsibility and the frequency of inspection. A table states the defects to look for on each component of the bridge. A further table details the likely defects, the causes and the required maintenance activity. Each maintenance activity is then dealt with in some more detail, with descriptions and diagrams giving a good level of detail. A few safety measures and temporary sign posting are also mentioned.

7.4.4. Roads maintenance management

The chapter on maintenance management, advises that the reader should already be familiar with the previous chapters and the other manuals. It states that ideas are put forward, which will allow the foreman to manage maintenance according to his resources. A definition for management is given, and in the case of roads maintenance, four basic activities are included: planning; organising; checking and reporting. Each activity is then discussed in detail. Maintenance activities are grouped according to the frequency of operation. The manual states an inventory should be set up, and an example of a map and list of items is given. The manual suggests ranking roads according to vehicles and road type, and an example is given. The effect of soils, topography and climate is also mentioned. Blank inspection forms for unpaved and paved roads are given, together with maintenance criteria, which includes:

Element; defects; criteria; action; programme and notes.

The manual talks of the foreman being able to answer the questions: What is needed and where is it needed? These are the basic management activities. A maintenance action form is provided. Organisation is covered next, which includes the issues of when should each maintenance activity take place, how long will it last and what resources are required. An order of priorities is recommended which adopts the priority matrix to assign priorities to different tasks. Performance standards are then given for a number of activities. Finally, it suggests that a detailed work programme can be produced. Checking includes field inspection and desk review and this should be followed by reporting. A diagram then gives a systematic description of the full management procedure covered in the chapter.

7.4.5. General observations

It would perhaps have been more effective (as has already been mentioned) to group together different aspects of the manuals for more impact. Perhaps the authors of maintenance manuals which followed these, took such issues into account. The information contained in the manual is again useful and adequately backed up by visuals. Perhaps the section on maintenance management would have been better placed with the sections from the other manuals which related to staff.

On the whole, the set of books is reasonably comprehensive, some of the subjects are however covered in far greater detail than others. Some subjects are covered in a step-by-step manner, which would allow the reader to follow exactly what was said in the manual and do the task accordingly, other sections only offer guidance.

This manual is a “this is what you should do and here is how to do it” type of manual.

8. MAINTENANCE INSPECTORS MANUAL. WAICHANGURU KENYA

8.1. General Information

The manual is compiled by L W Waichanguru for the Department of Staff Training, Ministry of Transport and Communications. The manual is dated 1984.

8.2. Proposed audience

The title suggests the manual has been written for a Maintenance Inspector, as part of a programme of work to maintain rural access roads.

The manual is A4 in size, and is a photocopy of the original supplied by ASIST. The manual has just under 40 pages, which are numbered. The manual has diagrams, and tables etc. The text is reasonably small and the font is serified. At first glance there is a larger quantity of text than diagrams.

8.3. Structure of manual

The document has a 'Contents' page with page numbers, and an introduction.

8.4. Scope of manual

Chapter 1 - Organisation, maintenance, classification of maintenance activities etc.

Chapter 2 - Motivation and human relations

Chapter 3 - Road maintenance management

Chapter 4 - Data requirements and inventory

Chapter 5 - Elements of maintenance of the carriageway

Chapter 6 - Elements of maintenance of the drainage system

Chapter 7 – Administration

8.4.1. Chapter 1

The purpose of the Inspector is explained as part of a programme of work to improve minor roads. An organisational chart for the Rural Access Roads Programme (RARP) is provided and the purpose of maintenance is defined as prolonging the life of the road, lowering vehicle operating costs and to 'enable greater regularity, punctuality and safety of road transport services'. Some of the factors which have hindered adequate maintenance of Rural Access Roads are listed as: lack of itemised activities and task rates, scarcity of trained manpower, increased traffic density, lack of supervision, lack of resources. A classification of maintenance activities is then split into routine, recurrent, periodic and urgent. Management in practice is split into: assessment of requirements, allocation of resources and monitoring. After listing a number of management techniques, the method of management by objectives is specified as the acceptable method.

8.4.2. Chapter 2

Motivation and human relations looks at the fact that financial reward is the main motivator for performance. It states that a piece rate system produces a higher output than a daily paid system. Other motivators are listed as: recognition or acceptability, creative ability and self-expression, security, development, and stimulation. The manual states that a competent supervisor should have the following skills: technical knowledge, responsibility, initiative, honesty, be hardworking and have the ability to organise and plan. The prevention of problems and the handling of problems are the aspects of human relations which are also mentioned. The manual goes on to look at leadership, problem prevention, treating people as individuals. Four steps to dealing with problems are given.

It has to be said that the section is obviously trying hard to prepare new supervisors for their new roles. However, whether or not it would actually help in practice is difficult to say, it is

⁷ Maintenance Inspectors Manual, Waichanguru, Kenya, p2.

simply written and the information is acceptable, yet, whether the new supervisor reading it would actually gain anything from the advice given is another matter.

8.4.3. Chapter 3

Road maintenance management is said to include four basic functions: planning, organising, controlling and reporting. The function of each is briefly given. The principles essential to management are specified.

8.4.4. Chapter 4

Assessment of requirements includes the data requirements, inventory and inspection, recording of defects, criteria for repair. The requirements of filling in forms to record defects are given however, examples of the filled in forms are not given only the blank forms. A table showing elements, (such as side drain), the defect, the action, and the type of maintenance is given. No diagrams are used and the information is quite brief.

Use of resources is also covered, in that an order or priorities are given to ensure limited resources are allocated effectively. The order given is urgent work, then routine drainage work, followed by recurrent drainage work, other routine work, periodic work and finally special work.

8.4.5. Chapter 5

Maintenance of the carriageway – Camber improvement, patching, reshaping, grass cutting, and bush clearing are given a paragraph each. The information is limited and only a few diagrams are provided, the first demonstrates a damaged camber, the second a well re-shaped road, a standard section for a carriageway is given. The information given is probably not of sufficient detail as no photographs are given, and step by step instructions are not provided. One can only imagine that it is because it is assumed that the reader already is fully aware of the procedures and the advice given is not therefore as detailed as it could be.

8.4.6. Chapter 6

The drainage system is discussed and the possible effects on the carriageway and slopes of high velocity water is given. The four functions of a drainage system are given: to convey rainwater, to intercept surface water, to convey water in a controlled manner, to control the level of the water table. Common drainage problems are listed, but again no diagrams are provided. Mitre drains are covered in more detail and a plan and a table of gradients and spacing is given. Similarly, scour checks are detailed and a table of gradients and spacing is provided. Catch water drains – an arrangement for them is given, but the advice given is not to use them as they can cause small land-slips. Culverts, drifts, bridges, and slopes are discussed in slightly more detail, but no diagrams are given and the information is reasonably limited.

8.4.7. Chapter 7

Recruitment – a page explains that a maintenance contractor should be engaged, and the public should be informed about the importance of the road and who the contractor is. Inspection routes – it simply states that the overseer should keep a record of his weekly movements on a form, (a blank copy is provided). The tools required by a contractor are listed, but pictures are not provided. With regard to site organisation, the manual states the information which should be kept. The case of urgent work is briefly discussed, and 3 alternatives for solving the problem of reorganising the work are given.

8.4.8. Appendices

The appendices contain sample maps, a maintenance inspection report form, a form for the engagement of a contractor, a summary of employment for maintenance contractors and a form for maintenance overseer's weekly inspection routes.

8.4.9. General observations

The manual would certainly benefit from the addition of some diagrams and photographs to demonstrate some of the points put across in the text. The information given is not of sufficient depth to allow someone with no experience to go out and do the job. It obviously assumes a certain level of experience. It is perhaps the type of book which a new supervisory recruit would be requested to read as part of his induction, but it is not the type of manual which one could imagine being in daily use. The manual is very basic and the quality of the presentation is low.

This manual is a “this is what you should do” type of manual and only occasionally shows the reader how to do it.

9. MAINTENANCE OVERSEERS MANUAL WAICHANGURU KENYA

9.1. General Information

The manual is compiled by L W Waichanguru for the Department of Staff Training, Ministry of Transport and Communications. The manual is dated 1985.

9.2. Proposed audience

The title suggests the manual has been written for a Maintenance Overseer, as part of a programme of work to maintain rural access roads.

The manual is A4 in size, and is a photocopy of the original supplied by ASIST. The manual has just under 20 pages, which are numbered. The manual has diagrams, and tables etc. The text is reasonably small and the font is serified. At first glance there is a larger quantity of text than diagrams.

9.3. Structure of manual

The document has a 'Contents' page with page numbers, and an introduction.

9.4. Scope of manual

Introduction

Maintenance of carriageway

Drainage maintenance

Administration

9.4.1. Introduction

A short introduction to the Rural Access Roads programme and the reason for adopting labour intensive methods paid by results is provided. An organisation chart for the present situation is followed by the new situation where Overseers are introduced to the structure. The intention being to remove the responsibility of maintaining the RAR from the Unit Supervisors and give it to the Maintenance Inspectors and thus the Overseers.

9.4.2. Maintenance of the carriageway

This section is exactly the same as that given in the Inspectors manual.

9.4.3. Drainage maintenance

Talks of the factors to be considered when dealing with water – both stagnant and fast flowing. The function of a side drain is stated. The common causes of blockage in an open drain are stated as: vegetation, rocks and stones and side walls falling in. Where scour takes place, it is suggested that scour checks should be used and a basic diagram the same as the one in the Inspectors Manual is provided along with the table of gradients and spacing. Mitre drains are defined and then a diagram is given (the same as that given in the Inspectors Manual), guidelines to the spacing of the mitre drains are also given, but the information given is not exactly the same as in the other manual, this may be because the other manual details the requirements for highly erodible soils, and this manual does not actually say that. A diagram of a catchwater drain (the same as that given in the Inspectors Manual), is provided and the purpose is specified. Interestingly this manual does not say that the use of such drains should be avoided as stated in the other manual. Culverts – the manual states the problems that blocked drains cause. The sequence in which damage will occur to the road is detailed and the agents of blockage are specified as: water carried debris and dumped debris. Structures – multiple pipe culverts and small span bridges – routine examination of the structures is said to be important and a list of guidelines for inspection is given.

9.4.4. Administration

Recruitment/ inspection routes and tools are exactly the same paragraphs as detailed in the Inspectors Manual. Inspection and reporting system – talks of the information which the

overseer should record as part of his dealings with his contractors, a blank form is provided in the appendix. The paragraphs on site organisation and work organisation which follow are the same as those given in the Inspectors manual. Lastly the manual states that the overseer should record his movements every week (this information is also given in the Inspectors manual).

9.4.5. Appendices

Form to record the road under maintenance and the contractors, form to record monthly work plan, maintenance weekly programme, a record of contractors, and an example of a map.

9.4.6. General observations

As with the Inspectors manual the Overseers manual would benefit from diagrams and photographs to demonstrate the points which it tries to put across. The information is brief and again, is probably not sufficient to allow a newly appointed member of staff to complete the tasks required without additional instruction. The manual is very basic and the quality of the presentation is low.

This manual is a “this is what you should do” type of manual and only occasionally shows the reader how to do it.

10. MAINTENANCE MANAGEMENT MANUAL – GREG J MARKS - LAOS

10.1. General Information

The manual is written by Greg J marks of Royds Consulting prepared for the International Labour Organisation employment intensive rural roads construction and maintenance. The manual is dated August 1997.

10.2. Proposed audience

The manual is intended to cover labour based rural road maintenance in Lao and has been written to assist maintenance engineers and technicians involved in the management of rural road maintenance using labour based techniques.

The manual is A4 in size, and is a photocopy of the original supplied by ASIST. The manual has over 50 pages, which are numbered. The manual has diagrams, and tables etc. The text is a reasonable size and the font is serified

10.2.1. Structure of manual

The document has a 'Contents' page with page numbers, an introduction and annexes together with a list of references.

10.3. Scope of manual

- Maintenance systems
- Road inventories
- Assessment of maintenance requirements
- Assessment of resource requirements
- Setting of maintenance priorities
- Preparation of maintenance work plans
- Implementation of maintenance work
- Reporting and monitoring
- Annexes

The introduction explains that the manual is intended to aid maintenance engineers and technicians through a maintenance management cycle. It is stressed that a rural road should be in a maintainable state, and time should not be wasted assigning resources to roads which are beyond maintenance. It points out that a newly constructed rural road is a significant investment and protection of the investment can be assured by the employment of local inhabitants as such people should have a vested interest in the road. Other important reminders about maintenance are given, but basically, it states that maintenance is not reconstruction every 4 or 5 years.

10.3.1. Maintenance systems

A definition of routine maintenance is given and the necessity for defining the activities: to quantify, instruct personnel responsible for implementation and control and monitor operations. The routine maintenance activities for unpaved and paved roads are given. Similar information is provided for periodic and emergency maintenance with bullet points and tables being used to good effect. Current labour based maintenance experience is provided for some sites in Lao. Proposed labour based methods – the advantages and disadvantages are highlighted for length person contracts and village contracts. Basically there is a choice between the methods which could be adopted and the issues to consider when making the choice are given as: funding, population density, and village structure. An organisational chart for the maintenance organisation is provided. Training requirements states that there is a misconception in the Public Department of Roads - PDR (?) that maintenance actually means reconstruction every 4-5 years. It states that a practical exercise would be to take a group through a maintenance management cycle, (which is provided in the form of a flowchart).

10.3.2. Road inventories

The manual states that the maintenance engineer should set up a road inventory and that it could take the form of a diagrammatic map or strip map and examples of each are given. The manual then lists other items which could be included as part of a detailed inventory. Road inventory forms are provided in English and Lao.

10.3.3. Assessment of maintenance requirements

The manual states that the maintenance engineer should be involved in the inspection of defects twice a year, but should also employ inspectors to undertake the bulk of the work. It states that the procedure is similar to the inspections required for inventory, but the condition is the important aspect to concentrate on. A list specifying the purpose of the regular assessment is given. The frequency of the assessments is given as every six months, one in the dry season and one in the wet. The manual states that the causes of deterioration should be identified, but does not give guidance on what they causes may be. The recording of defects is supposed to take place on inspection forms, a list of the principal defects to be identified are given in a table. A short explanation of each form to be filled in is provided, together with a blank copy of each form (one of which also appears in Lao).

10.3.4. Assessment of resource requirements

The manual states the four resources required as: money, materials, labour and equipment. Technology selection – a table and accompanying paragraph demonstrates the potential for using labour based and equipment based methods for each activity. Diagrams showing the typical cross sections for labour and equipment based maintenance are given. Some advice is given to be considered when choosing labour based methods, such as: is labour available, health and nutrition of the labour force need to be considered etc. The resource requirements depend on the productivity levels for each activity, a table indicates desirable performance standards (a range of outputs for each activity is given). The use of contractors is considered and a list of activities are presented which can effectively be contracted out, and may result in savings in money. Four different types of labour based contract are listed: length person, petty contract, small scale contract for a road, small scale contract for a network. Points to be considered before choosing the type of contract are given as: supervisory capacity, cultural limitations to be considered, distribution of people along the road.

10.3.5. Setting of maintenance priorities

It is stated that resources are not always sufficient to carry out all maintenance activities identified by the assessment, therefore prioritisation is necessary. The manual states that priority must be given to emergency maintenance, and a percentage of the budget should be set aside to cover such work. The next priority should be to drainage. Suggested priorities are given for routine maintenance activities for paved and unpaved roads. With regard to the importance of certain roads, those that carry large amounts of traffic are important, along with other strategic roads which may carry lower levels of traffic. A table of classification based on traffic level is given. A priority matrix is used to show how maintenance activities may be prioritised along with traffic level. The manual states, that whatever the priority used, the 1st priority should be the maintenance of existing roads, then the upgrading of existing roads, followed by new construction. Adaptation of priorities to local conditions, to include local conditions is also important. Determining the work program, involves the comparison of the resource costs for the proposed maintenance work with the available funds. A form to assess the resource requirements and cost estimate is provided.

10.3.6. Preparation of maintenance work plans

Once the required activities have undergone a prioritisation exercise, the work plans can be produced. The manual states that the following elements must be defined prior to the production of a maintenance plan: Maintenance and operations activities, maintenance feature inventory, technical standards, productivity standards, and available resources. Long and short term plans are mentioned. A number of forms are provided, which make up the planning process: annual needs assessment of maintenance, annual planning of routine maintenance form and a productivity standards form for routine maintenance.

10.3.7. Implementation of maintenance work

Schedules are specified as the instructions for the Foreman supervising work on a daily basis, as they will tell the Foreman the quantity of work, labour, equipment and materials required. Worksheets are specified as the method by which output may be measured against targets. Blank forms are given, and the daily work form for road maintenance appears in Lao in addition to English.

10.3.8. Reporting and monitoring

The manual states that reporting is only of use if it can be compared with the original planned targets and it reflects the actual performance. It is stated that monitoring is the most important aspect of the maintenance management cycle. Site inspections – the engineer should be involved in this procedure, which can be undertaken through slowly driven and walked inspections. A desk review should also be undertaken, which involves assessing all the maintenance documentation (inspection reports, resource requirements forms, work schedules and completed worksheets).

10.3.9. Annexes

The annex contains a supply of blank forms, copies of which appeared throughout the manual itself.

10.3.10. General observations

The manual is well written and the subjects covered and done so in detail. Bullet points, step by step instructions, diagrams and tables are used effectively and the style and presentation makes the manual easy to read. The manual does not cover everything, but what it does cover: setting up a maintenance system, is covered well. Whether or not the level of detail would be achieved at the level specified (rural roads) is another matter. The information could be added to that from other manuals to make a very concise document. What is covered by the manual is covered well and with style.

This manual is a “this is what you should do and here is how you should aim to do it”.

11. FIELD MANUAL - LABOUR BASED RURAL FEEDER ROAD MAINTENANCE RFRM TRAINING PROJECT LAOS

11.1. General Information

The manual is written by the Rural Feeder Road Maintenance Training Project, (an ADB project). The manual is dated October 1996.

11.2. Proposed audience

The manual is intended for use by supervisors of rural road maintenance using labour based work methods. (The Foreword is written by Greg J Marks). It is written in English and Lao.

The manual is A4 in size, and is a photocopy of the original supplied by ASIST. The manual has around 40 pages, which are numbered. The manual has a large number diagrams and sketches, some of which resemble those in the PIARC manuals and some tables. The text is small and the font is serifed

11.2.1. Structure of manual

The document has a 'Contents' page with page numbers, a 'Foreword', and a list of references.

11.3. Scope of manual

The manual covers the following topic areas:

Inspection and removal of obstacles

Cleaning of drainage structures

Repair of drainage structures

Cleaning of turnout drains, catch water drains etc

Cleaning of side drains and excavation to original sizes

Maintenance of erosion controls in drains

Repair of shoulder and slope erosion

Repair and filling of potholes in carriageway

Light reshaping of carriageway etc

Cutting of grass on shoulders and side drains

Bush clearing and tree removal

The manual does not have an introduction, but the Foreword states that the manual is supposed to be a simple guide for supervisors, it covers routine maintenance only. "It is not a manual with detailed information on how to organise and execute such works as using labour based methods, but is to be a field book for those who have had more comprehensive training"⁸.

11.3.1. Inspection and removal of obstacles

The supervisor and the contractor should inspect the site first to establish the extent of the work. The removal of landslide debris is covered using a diagram and text. Removal of fallen trees and boulders are dealt with in a similar manner with step by step instructions and effective sketched diagrams.

11.3.2. Cleaning of drainage structures

Culvert inlet and outlet structures, drop structures, culverts, drifts and vented drifts are mentioned. The tools required are listed and diagrams given.

⁸ Field manual - labour based rural feeder road maintenance RFRM training project Laos, Foreword.

11.3.3. Repair of drainage structures

Culvert repair is split into: erosion repair, inlet and outlet structures – with step by step instructions given. Crack repair, headwall and apron repair, repair of inverts, construction outfall basin, drift and vented drifts, pothole repairs to slabs, replacement of guideposts, bridge cleaning/ clearing, flood/ wind debris, termites, repair of loose/ missing connectors and fixings replacement of damaged planks, painting and debris control at structures, are all dealt with in a similar way with step by step instructions, tools needed and sketches of what to do.

11.3.4. Cleaning of turnout drains, catch water drains etc

The section on turnout drains gives a table specifying turnout drain interval with the gradient of road. An explanation of the purpose of a catch water drain, is followed by the cleaning and reshaping of turn out and catch water drains.

11.3.5. Cleaning of side drains and excavation to original sizes

The function of the side drain is given, and the cleaning and reshaping is also covered.

11.3.6. Maintenance of erosion controls in drains

Scour checks are discussed and a table of scour check intervals related to the side or turnout drain gradients is given.

11.3.7. Repair of shoulder and slope erosion

Removing of obstructions, reshaping of shoulder are both specified as routine activities and step by step instructions are given. Adding shoulder material is specified as a periodic activity. The repair of slope erosion (as a periodic or emergency activity) is split into – reducing the slope angle, clearing slip material and surcharging the slope are all specified as minor repairs. Gabion retaining walls (for stabilisation), masonry retaining walls, concrete retaining walls are all classed as major or permanent repairs. Berms for cut slopes, catch water drains for cuttings, turfing, seeding and stone pitching are covered in similar detail with plenty of diagrams and instructions.

11.3.8. Repair and filling of potholes in carriageway

A routine maintenance activity, where step by step instructions for the procedure, together with diagrams are given, together with detailed instructions on how to execute the work, and the signing required.

11.3.9. Light reshaping of carriageway etc

Diagrams of: lack of camber, ruts, corrugations, soft spots, potholes and erosion gullies are provided, (some of the sketches are the same as those which feature in the PIARC manuals). The temporary sign posting is also given.

11.3.10. Cutting of grass on shoulders and side drains

This routine maintenance activity is described, and split into grass cutting, the use of herbicides and burning.

11.3.11. Bush clearing and tree removal

A procedure for bush clearing and the felling and removal of trees is given, with diagrams.

11.3.12. Appendix

The appendix contains a list of the required tools with diagrams of each, (the same diagrams as those used in the PIARC manuals). A list of references is also given.

11.3.13. General observations

The manual is written in the style of the PIARC manuals, but as it intends to be a field book, it would benefit from being smaller. (The book has been photocopied as A4 size, but the original may in fact be smaller). The explanations are detailed and in a simple form. The manual is effective at what it aims to do, and that is to guide supervisors dealing with labour based maintenance. The order of priority is set up, by the order in which the manual deals with each subject. The fact that the manual also translates the text into Lao, must be a positive step.

This manual is a “this is what you should do and this is how you do it” in a very simple way.

12. FOREMANS SITE MANUAL - SCOTT WILSON KIRKPATRICK – MALAWI

12.1. General Information

The manual is written by the Secretary for Works and Supplies and Scott Wilson Kirkpatrick. The manual is not dated.

12.2. Proposed audience

The manual is intended for use by Foremen, (as stated in the title). There is supposed to be an introduction, but the photocopy supplied by ASIST is unfortunately missing its introduction page. The manual is A4 in size, (and is a photocopy of the original supplied by ASIST). The manual has over 150 pages, which are numbered. The manual has a large number diagrams (mostly hand drawn sketches). The text is also hand written, and is a reasonable size.

12.2.1. Structure of manual

The document has a 'Contents' page with page numbers.

12.3. Scope of manual

The manual covers:

- Setting out roadworks
- Site clearance
- Earthworks
- Drainage
- Gravelling
- Concrete
- Culverts
- Bridges
- Drifts
- Erosion protection work
- Maintenance
- Site organisation
- Site administration
- Standard details

12.3.1. Setting out roadworks

All the text and sketches are hand drawn. Some of the text is written in boxes for emphasis and some is written in large letters. This method of drawing the attention, works well. The method of setting out is covered and the necessary equipment is shown. A method for setting out a straight and also curves are covered, together with setting out right angles. The methods given are very simple yet effective.

12.3.2. Site clearance

A method for measuring the area to be cleared is provided, together with a method for removing boulders. The issue of compensation is briefly covered. Activities and task rates for particular activities such as: tree and root removal are provided and include the required tools, the a rate in some cases.

12.3.3. Earthworks

Levelling, embankments and cuttings are covered. A chart giving group task rates is provided. Much information on levelling is given. A section on measuring volumes, looks at the slots which need to be cut as part of the levelling procedure. Examples of how to calculate the volume of levelling to be achieved with a certain number of men is given. Level and stability control are covered. An explanation of embankments and the necessary

calculations, together with advice on the organisation of the work is provided. Cuttings are also explained in the same way.

12.3.4. Drainage

The elements of a drainage system are specified and a diagram is used to good effect. The manual states that a road must be levelled properly to ensure a good drainage system can be engineered. Various types of terrace are defined. The equipment used in drainage work is depicted, with measurements, (where appropriate). Side drains and (other types of drains) are explained, a setting out procedure is specified, followed by the organisation of the work, and the control of the work. In all cases, the information is detailed and the diagrams are effective. A section on improving the side drains and camber on existing roads gives the road shape and the faults, together with the required improvement work.

12.3.5. Gravelling

The manual states that gravelling is a procedure which should be carried out after the structures and all other road works have been completed. A good gravel is specified as: strong, not slippery and easily excavated. A specification for a good gravel is given as: 50% stone for strength, 40% sand to fill the gaps between the stones, 10% clay to help bind the sand and stones together. The gravelling procedure is detailed. The organisation of loading in the quarry is detailed, along with the organisation of labour in the quarries.

12.3.6. Concrete

Concrete is explained, and then the manual details cement, aggregate and water and explains how to mix concrete, using a gauge box. Step by step instructions are given for mixing concrete. Placing concrete is dealt with next, then testing it, using the slump test. The section goes on to give a casting yard layout for making culvert pipes, and then how to make culvert pipes (placing, stripping and curing). Organising labour in the casting yard, with task rates is given, and an example of a casting yard record.

12.3.7. Culverts

The purpose of a culvert is detailed and the two different types of culvert: stream and relief are defined. The procedure for constructing a culvert is provided, including: siting, setting out, fixing culvert line and level, constructing culvert outlets, stockpiling materials, making detours, excavating trenches, laying and backfilling pipes, making culvert ramps, headwall construction. Improvement of existing culverts is also covered: widening existing lines, and enlarging existing lines. As before, much detail is given, including dimensions etc.

12.3.8. Bridges

The elements that make up a bridge are listed and defined. A procedure for constructing a bridge is given: setting out, excavating foundations, foundation slabs, masonry work, weep holes, deck markers, backfilling of abutments and wing walls, decking, selecting bearers, launching bearers, raising bridge deck, fixing decking timbers, chassis cross members, running boards and deck markers.

12.3.9. Drifts

The reasons for using a drift are listed and the two types of drift: 'at-level drifts' and 'vented drifts' are detailed. A step by step construction procedure for drifts is provided.

12.3.10. Erosion protection work

The places where erosion can be a problem are stated and explained with the use of diagrams. Methods of reducing the speed of water in side drains using scour checks is detailed and a step by step procedure to setting them out is provided. Stone pitching and embankment side drains, culvert outlets and bridge piers and abutments are also detailed.

12.3.11. Maintenance

The section correctly states that as soon as the road is constructed, deterioration will commence. A diagram of a newly improved road is given to demonstrate all the elements which should be in place. Routine, emergency and periodic maintenance are briefly introduced and then what each one involves is covered in more detail. For example: cutting grass, cleaning out mitre drains, filling in ruts and potholes, repairing scour checks, planting grass, cleaning signs etc are all part of routine maintenance. The manual states that no section of completed road should be left without a maintenance labourer. The foreman should visit the labourers everyday. An activity chart shows which activities should be undertaken at which times of year. Emergency maintenance is very briefly covered, and periodic maintenance activities are mentioned, but not detailed. A table of when each activity should be undertaken is provided. The section definitely covers routine maintenance in more detail than the other types of maintenance.

12.3.12. Site organisation

The manual states that there are six basic operations which make up road improvement work, each being made up of several activities. For example: the operation of *earthworks* is made up of the activities of: excavation, hauling and spreading. This section of the manual specifies how to organise gangs of labourers working on the following operations: supporting, clearing and stumping, earthworks and drainage. Two systems of organising labourers are quoted: day work and task work, (the task work system is said to be better). However, the work has to be measured, a fair rate of work has to be chosen, each labourer must know exactly what to do, close supervision is required. The task rates given in the manual are for guidance only and the reader should calculate appropriate task rates to reflect local conditions. However, a step by step procedure for establishing task rates for activities is given. Advice is given on starting up a site, which includes: establishing the labour force, and then a 4 week plan for getting a site started. Planning is briefly introduced and the site quantities book, together with an example of a filled in page. A blank daily work programming form is provided and step by step instructions on how to produce a daily work plan. Effective worked examples, helps the reader to understand the process.

12.3.13. Site administration

This section covers the recruitment of labour, redundancy, time keeping, payment, store keeping, accommodation, monthly reporting – roadworks report and structures report (including form filling). The section gives detailed information on how to administer a site from the foreman's viewpoint.

12.3.14. Standard details

Standard details for: road cross sections, embankments, T junction layouts, culverts, headwalls, multiple culvert line, abutment details, pier details, decking layout, deck cross section and stream level drift.

12.3.15. General observations

The manual contains a lot of quite detailed information, yet the hand written style makes it easy and interesting to read. It is perhaps rather reminiscent of a school book, and is on occasions bordering on being patronising, for example: the use of "NO!" and "YES!" to explain how to undertake certain tasks, can become rather annoying if over used. Sometimes, it feels as though there is almost a mismatch between the information being put forward, (due to it's detail) and the simplistic format. The manual is very methodical and seems to try and cover all of the aspects which a foreman would need. It does not cover maintenance management and programming in any great detail, however this is probably because the supervisor would be dealing with it. The manual is not exactly in a 'pocket' format and the information could possibly have been split into sections which could then be carried in the pocket, as with the PIARC handbooks or those used in PNG. It is difficult to say whether the manual is actually used in practice, no evidence of it was seen in Malawi. A problem with such manuals is that they are often produced as part of a specific project, such as this one: District Roads Improvement and Maintenance Project (DRIMP) and once the project is finished, they end up on a shelf, which is a great shame. A lot of effort has

obviously gone into producing the manual, interestingly, if it were word processed it would probably lose the simplistic feel, which is what makes it so good.

The manual is a “this is what you should do and this is how you do it” – in a simple way.

13. VEGETATION STRUCTURES FOR STABILISING HIGHWAY SLOPES - A MANUAL FOR NEPAL (HIS MAJESTY'S GOVERNMENT OF NEPAL & ODA)

13.1. General Information

The manual is produced by His Majesty's Government of Nepal, with assistance from the ODA. The manual is dated March 1991, with the current edition being 1996. The list of authors includes C. Lawrence from TRL. Apparently, the document was produced in large quantities, to allow it to be freely distributed in Nepal. Thus overcoming the problem of 'not reaching the intended audience'. 'This is a manual about Nepal, and there is nothing in it which has not been tried and tested by the authors in the rigorous conditions of Nepal'⁹.

13.2. Proposed audience

'The manual is intended for use by any engineer, forester or agriculturalist who is faced with problems of slope stability'¹⁰.

13.3. Aesthetics of manual

The manual is just under A4 in size, and has cardboard covers with a photograph. The manual has just under 200 pages, which are numbered. The pages are slightly glossy, the manual is in black and white, with diagrams, photographs, sketches and tables etc. The text is small and the font is serifed.

The manual uses small sections of text in black borders for emphasis, which works well. However, due to the size of the text and the amount on each page, it is slightly difficult to read for long periods due to the quantity of material contained on each page.

13.4. Structure of manual

The document is well laid out, with a 'Contents' page with page numbers, a list of 'Abbreviations', 'Foreword', a 'List of Figures', a 'Dedication', an 'Introduction', 'References', 'Further Reading' and 'Appendices'.

13.5. Scope of manual

'....it explains the methods that are available for this purpose (problems of slope stability). It does not provide simple answers because there are not simple answers. Instead, it provides a framework in which to approach each specific problem'¹¹.

The manual is split into the following Chapters:

Introduction

Environment and slope

Vegetative stabilisation techniques

Small scale engineering techniques

Planning and organisation

Implementation

It is not proposed to review the contents in detail, as they are of a very specialist nature. However, the amount of information covered is very comprehensive, even down to 'Staff qualifications and job descriptions', with a 'management structure'. The sketches used in the

⁹ Vegetation structures for stabilising highway slopes A manual for Nepal, His Majesty's Government of Nepal & ODA, p1.

¹⁰ Vegetation structures for stabilising highway slopes A manual for Nepal, His Majesty's Government of Nepal & ODA, p1.

¹¹ Vegetation structures for stabilising highway slopes A manual for Nepal, His Majesty's Government of Nepal & ODA, p1-2.

manual are simple, yet very effective. Thought has obviously gone into the presentation of the document, with respect to the proposed audience.

The following example shows the format adopted for the dissemination of information:

Palisades of cuttings - Function, Sites, Materials, Method, Advantages, Disadvantages, Where to use, Timing, Spacing, Later management, Costs, Comments.

Protection of roadside slopes - Aim, Methods, Fencing, Guarding, Working with people.

Thus the manual adopts a staged approach, which seems effective. The manual would have benefited further from the addition of colour, however it is obvious that costs were kept down to ensure the document could reach as wide an audience as possible.

14. OVERSEAS ROAD NOTE 16 - PRINCIPLES OF LOW COST ROAD ENGINEERING IN MOUNTAINOUS REGIONS. TRRL CENTRE TRL

14.1. General Information

The manual is produced by the Overseas Centre (was unit) at TRL and is dated 1997. The 'Foreword' by Professor Fookes, includes the following explanation: 'I believe that this note is needed because there has been nothing so comprehensively available hitherto and the subject matter is important to those who build in high mountains. It deals with the mountains themselves, their behaviour, investigation and construction on their slopes and represents a state-of-the-art survey in both conceptual and practical aspects'¹². Whether or not the note is available in languages other than English, is not stated.

14.2. Proposed audience

The proposed audience is described as: '....while the guide has been prepared for practising road engineers, both in the private and public sector, some of it is aimed specifically at specialist support staff, such as geotechnical engineers and hydrologists'¹³. The manual is based on a mix of tables, figures, graphs, diagrams and photographs and is predominately in black and white, with the occasional colour picture.

14.3. Aesthetics of manual

The manual is A4 in size, with glossy cardboard front cover in colour. The manual has over 150 pages, which are numbered. The manual has 13 sections (chapters), which are listed at the front of the document in the 'Contents', together with a 'Bibliography'. The size of text varies considerably, depending on the information. The font is a mix of serified and unserified.

The quantity of visuals to text is reasonably high, with most pages having at least a table or diagram or photograph of some sort and annotation is used..

The manual is very 'glossy' and not the type of book you would want to ruin in the field. The layout is quite different to ORN 1 & 2, and the manual would probably be a useful reference document to many different types of people. The document is not however a manual, in the sense which we are interested, it is an important reference source.

14.4. Structure of manual

The manual contains an 'Acknowledgement', 'Foreword', 'Preface', 'Contents' with page numbers, and a 'Bibliography', also information on where to obtain copies of the manual. The visuals are numbered, yet a list for easy reference is not provided.

¹² Overseas Road Note 16, Overseas Centre, TRL, 1997, piii.

¹³ Overseas Road Note 16, Overseas Centre, TRL, 1997, p2.

14.5. Scope of manual

The manual contains the following sections:

- Introduction
- Geographical settings of the Nepal Himalayas
- Engineering problems
- Planning and design overview
- Desk study and reconnaissance survey
- Environmental impact assessment
- Geotechnical assessment
- Hydrology and hydraulic design
- Earthworks
- Drainage
- Road retaining walls
- Slope protection and slope stabilisation
- Road construction along valley floors

It is not proposed to discuss in detail what the report does, and doesn't cover. However, of particular note is the way in which information is put across. For example: the use of 'boxes' which are shaded with a border to emphasise important information. The Roads and Bridges Design Manual uses a similar method, where advice is written as part of the text and elements which must be followed to the letter, i.e. rules, are placed in borders for emphasis. One of the boxes contains instructions on the 'construction of gabions' which supplements the diagrams on the 'typical details for gabion and reinforced earth retaining walls'.

The document contains the sort of information you would want to know prior to carrying out engineering works in Nepal, but it could also be used as a handy reference book for particular problems.

15. A SERIES OF 8 ROAD MAINTENANCE FIELD MANUALS GOVERNMENT/ ROUGHTON INTERNATIONAL PAPUA NEW GUINEA

15.1. General Information

The manual is produced by the Department of Works in PNG, and there appears to be no date on the manuals. The manual is split into 8 individual books or volumes, each covering a specific topic area. Roughton International Ltd., were apparently involved in the writing of the manuals.

15.2. Proposed audience

The proposed audience is specified as field staff.

15.3. Aesthetics of manual

Each of the 8 manuals are A5 in size, with glossy cardboard front cover in colour. The manual is based on a mix of photographs, tables, and diagrams and is in black and white. The number of pages in each manual varies, with the largest having around 40 pages, the pages are numbered. The size of text acceptable and the font is bold and unserifed.

The quantity of visuals to text is high, with most pages having at least a table or diagram or photograph of some sort.

The manual is quite 'glossy' and all the text appears in English and the local language of PNG.

15.4. Structure of manual

The first volume of the series contains a brief introduction to the series. Each volume has its own contents page.

15.5. Scope of manual

The sections are split as follows:

- Road maintenance management and glossary of terms
- Safety at roadworks
- Common defects
- Routine maintenance
- Periodic maintenance, resheeting and resealing
- Bridges and culverts
- Road making materials
- Plant and vehicles

15.5.1. Road maintenance management and glossary of terms

Sensibly, Section 1 gives a quite comprehensive list of terms, (although strangely the Glossary starts on page 10 and not page 16 as stated in the contents!). The manual explains why road maintenance is important and then goes on to introduce the set up of the organisation (the Department of Works). The road maintenance budget is divided into five votes and these are listed as: Routine, Special routine, Emergency, Periodic, Specific, (the type of activities in each is specified). The maintenance section's responsibilities are listed. The provincial responsibilities – budget estimates: it is specified that the Provincial Managers should submit lists of schemes which should be carried out in a priority order. The submissions should be analysed by headquarters and then the Provincial Managers should be advised of the funding levels. Work planning and scheduling – once the budget allocation is known the workload can be planned. Research and training is briefly mentioned, in so far as it should be encouraged. Supervision and monitoring – a brief explanation of the purpose is given. The inspection – It is stated that inspection is important, and the maintenance engineer should walk his sealed roads and drive his gravel roads once a year. The

supervisor should also carry out an inspection of the roads and bridges twice per year. The functions of an inspection are listed.

The manual is very much an introduction to the rest of the sections. The information sets the scene, rather than explaining anything in very great detail. The reader would probably come away with an understanding of what maintenance means in PNG, but not necessarily an idea of how to do it.

15.5.2. Safety at roadworks

The principles of safety at roadworks are introduced, the principles of good signing are given. The traffic signs to be used are specified, with diagrams and an explanation of the meaning of the sign. The positioning of the signs are then discussed – a list of step by step instructions for setting up signs is given. Layouts for the signs are then given for different types of work on the carriageway.

15.5.3. Common defects

The contents of this manual are split into: road pavement (sealed road), gravel road, shoulder or verges, drainage, traffic signs/ roadmarkings/ roadside furniture, structures. Firstly, the type of pavement or item is defined and then the common defects are specified and demonstrated with a photograph. In some cases a remedy is suggested and in other cases the manual suggests another volume in the series which covers the remedy. Some of the photographs are rather pale, making it slightly difficult to see the problem. The use of photographs to demonstrate the defects is always effective, however, it is not totally effective in this case, as the photographs are not good quality. Colour would have helped.

15.5.4. Routine maintenance

A definition of routine maintenance is given. The activities are then listed for sealed roads, gravel roads, shoulders and verges, drainage, traffic signs etc. It is suggested that inspections by the supervisor should take place at least every 3 months. The manual states the purpose of the inspection. A step by step instruction for activities such as patching potholes on sealed roads is then given, using photographs. Interestingly, not all the activities are demonstrated using photographs, which is a shame, as they do make the procedures easier to understand. Generally, all activities are dealt with in the same way. An appendix gives some alternative types of camber boards.

15.5.5. Periodic maintenance, resheeting and resealing

An explanation of the difference between routine and periodic maintenance is given. An explanation of resheeting is given, the purpose of the officer responsible for the work is specified, together with a list of his required job activities and responsibilities. The resheeting operation is then specified, with regard to what the supervisor will have to do, for example: identify gravel sources etc. The effect of resheeting is briefly stated, for example: it improves riding quality etc. It is stated that the materials should be from an approved source and the laboratory should be requested to undertake testing. The necessary plant and equipment is listed. A step by step procedure is then given, with photographs and diagrams, to undertake the resheeting operation. A gravel dump space chart is provided. The management duties of the supervisor are given for the resheeting operation, split into before/ during/ after.

The resealing operation is then dealt with in exactly the same way, as already stated. Binder and aggregate application rates are given, together with advice on binder application. Unfortunately the photographs lack definition, making it difficult to understand the procedures demonstrated.

15.5.6. Bridges and culverts

The introduction stresses the importance of maintaining highway structures. Advice is also given on when to carry out the inspections, forms which should be filled in (blank copies of which are supposed to be included at the back of the manual, but they do not appear to be there). A guide to carrying out inspections is provided and photographs are used to good effect. Most of the manual is in fact taken up with the inspections of structures, only a small

amount of the manual is given over to repairs, and few diagrams are used to demonstrate the repairs. Step by step instructions are given for replacing and laying culverts.

15.5.7. Road making materials

The introduction states that the section will give supervisors, foremen and overseers basic information about materials. The object of a road is explained using a diagram to show the different layers, and an explanation of each. Materials are then discussed in more detail, with an explanation of what topsoil is, followed by what constitutes a good road material. The identification of soils is covered: Rock, gravel, sands, silts and clays are described, but diagrams are not used. Soil compaction is explained. The tests undertaken in the laboratory are named, but are not explained. Resheeting and gravel patching, a table is given to guide the reader on the type of materials suitable for resheeting and patching, based on particle size distribution. Photographs are used to good effect to demonstrate a plastic surface. Some advice is given on plasticity and the maximum size of aggregate to be used. Aggregates for resealing are discussed, and a table giving the acceptable size limits for resealing aggregate is given. Photographs demonstrate 'well shaped' as opposed to 'flat' chippings. The different types of binder to be used are explained. Premix material is briefly introduced, and a grading for the aggregate is given. Bituminous slurry mixes are covered in the same manner. Concrete is also covered, and a brief guide on how to undertake a slump test and strength test is provided. (It perhaps seems rather strange that the slump test and strength test were covered and the lab tests were not, one can only imagine the reason for this anomaly is due to the fact that the concrete test may be carried out on site and the other tests would not be). However, for completeness, it might have been wise to include a brief explanation of the laboratory tests mentioned in the text.

15.5.8. Plant and vehicles

The manual aims to describe the main types of equipment and cover their capabilities and care from the operators view. The aim appears to be to give the supervisor an understanding of the plant and vehicles. The possible causes of breakdowns are given, and what can be done to avoid such occurrences. A step by step guide to daily checks is provided using photographs. A service and maintenance schedule for commonly used plant and vehicles is given, laid out in daily, weekly and 3 monthly checks. Graders, dozers and front end loaders are covered separately. A number of other more specialised pieces of plant are then defined, such as: the bitumen distributor, the chipping spreader, the pneumatic tyred roller, the steel wheeled roller, the motor grader, the front end loader, the tracked dozer and the lorry.

15.5.9. General observations

The set of manuals is well laid out, and the choice of subjects placed together make sense. Lots of photographs are used, but it is a shame the definition of the photographs is not better, as the lack of definition detracts from the effectiveness. The manuals cover the range of topics one might expect a field supervisor to know about. The only topics not covered in any detail are staffing issues, and the planning and management process. However, this is probably because the field supervisor would not be expected to deal with such topics on a daily basis. The best element of the manuals, is the fact that they are small and split into topic areas, making it easy for the reader to locate the item he requires, without having to look up the information in a large book.

This manual is a "this is what you should do and this is how you do it" manual.

16. BETTERMENT AND GRAVELLING MANUAL. NATAL ROADS DEPARTMENT SOUTH AFRICA

16.1. General Information

The manual is produced by the Natal Roads Department in South Africa, and is dated June 1987.

16.2. Proposed audience

The Foreword states that: 'The manual has been compiled by the M.A.S.H (Maintenance Advice and Services Head Office) Quality Circle and has been accepted as policy by the Maintenance Division for betterment and gravelling work'¹⁴. The proposed audience is not, however the type of work to which the manual refers is very specific and therefore the work topic rather than the audience is important. .

16.3. Aesthetics of manual

The manual is A4 in size and is a black and white photocopy of the original supplied by ASIST. The manual is mostly text with some tables, and diagrams. The manual has approximately 30 pages. The size of text is quite small and the font is bold and serified.

The quantity of visuals to text is low, with most pages being generally just text.

16.4. Structure of manual

The manual has a 'contents' page, (or index as it calls it), and a 'Foreword', page numbers are not used.

16.5. Scope of manual

The manual covers the following topics:

- Objectives
- Policy
- Planning
- Execution
- Road traffic signs etc.
- Annexes

16.5.1. Objectives

'The objective of this manual is to define the required standards and procedures for the betterment and gravelling of provincial and district gravel roads'¹⁵.

16.5.2. Policy

The objectives of betterment work are stated as: to improve safety and comfort of motorists; provide adequate drainage to prevent scour; and to prevent erosion.

16.5.3. Planning

3 to 5 year advance planning, 6 to 12 month advance planning and 1 to 6 month advance planning are dealt with in this section. The manual states that with regard to the betterment and gravelling programme, a three year programme should be kept up to date. At the start of each year, an annual programme should be prepared. An inspection of the road should also be carried out to ascertain which structures require attention and this should be placed on a five year structures programme.

¹⁴ Betterment and gravelling manual, Natal Roads Department South Africa, 1987, (Foreword).

¹⁵ Betterment and gravelling manual, Natal Roads Department South Africa, 1987, p1.

The 6 to 12 month advance planning consists of whether minor realignments are necessary, whether the road reserve width is adequate, the details of encroachments to be move and any culvert requirements, also the locating of quarries and borrow pits, general drainage issues. Each is explained in more detail by the manual, where some specifications are provided along with advice on inspecting. Removal of services is also briefly covered. The manual basically specifies that certain standards must be met as part of the betterment process.

The 1 to 6 month advance planning, considers the inspection of accesses, and some measurements are provided, such as shoulder sight distance. Accommodation and camp sites and care of encroachments are covered

16.5.4. Execution

Inspection frequencies for different levels of staff are stated. Signing requirements are specified, yet no diagrams are provided, which is a shame. The manual points the reader to a separate manual for the signing requirements. Setting out – the manual briefly talks of setting out alignments using pegs, but directs the reader to another manual for further details. Site clearing – removal of vegetation is very briefly mentioned. Raising and widening of gravel roads – a brief explanation is given, but no diagrams are provided. Meadow drains – the purpose is stated and some dimensions provided, but again the reader is directed to the annex for a standard detail, which would have been better placed in the text. Compaction – the method to achieve compaction is specified. However the information given is very brief, and would have benefited from further information, for example: the type of roller to be used is not specified. Camber and superelevation – the description given for camber is as follows: 'set out the camber to 3.5% using the adjustable template described in Activity GM 09 of the Performance Standards Manual. The adjustable pipe on the template to be set at 105mm. After the camber has been shaped, a variation in camber between 3% to 4% is acceptable'¹⁶. The description is adequate, yet the reader has to refer to another manual and also to the annex for the standard details. It would have been more effective to provide some diagrams to help the reader. The explanation of superelevation is undertaken in a similar way.

Road drainage is dealt with in slightly more detail, with some diagrams and tables being provided. The maximum distance between points of discharge for particular road gradients are given. Pipe and portal culvert installation – as before the reader is directed to the Performance Standards Manual, a table giving the minimum cover for culverts is also provided. Inlets and outlets – the reader is again directed to the Performance Standards Manual. The provision of mitre drains and protection works – slightly more detail on the provision is provided thanks to some diagrams.

Gravelling – the information is split as follows: dumping; quality; thickness; quantity; capacity of truck; traffic accommodation; setting out gravel width; processing; spreading and compacting, and final levelling and clean-up. The information given in most cases is very brief, for example the paragraph on quality: 'Material may only be used from an approved quarry. Regular supervision of the quarry is necessary to ensure only approved material is used'¹⁷. The information is very brief and in some cases points the reader towards the Performance Standards Manual.

16.5.5. Road traffic signs etc.

The section states that a superintendent should assess which signs are required prior to the commencement of the work and reference should be made to the South African Traffic Signs Manual. Kilometre posts should be correctly positioned, guard-rails erected only where strictly necessary and roadway features marked.

16.5.6. Annexes

The Annex contains the following information:

A blank strip plan form

¹⁶ Betterment and gravelling manual, Natal Roads Department South Africa, 1987, p4.5.3.

¹⁷ Betterment and gravelling manual, Natal Roads Department South Africa, 1987, p4.7.2.

Agreement form for the realignment of road
Indemnification form for the responsibility of dams
Culvert schedule form
Provincial road (gravel surface) cross sections
District road (gravel surface) cross sections
Table of loose and compacted layers of gravel

16.5.7. General observations

The manual is quite specific in that it covers only betterment and regravelling. It tends to point the reader to other manuals or the annex rather than expand on the information it gives. There are insufficient visual aids. The information given would probably not be sufficient for someone who did not already have experience of the methods and practices which the manual puts across. Some of the tables are useful, but on the whole the manual is not as informative as it could be, and is not as easy to follow as some of the other manuals.

This manual is a “this is what you should do, but you should already know how to do it or you will have to find out elsewhere” type manual.

17. TRH 20 - THE STRUCTURAL DESIGN, CONSTRUCTION AND MAINTENANCE OF UNPAVED ROADS COMMITTEE OF STATE ROAD AUTHORITIES SOUTH AFRICA

17.1. General Information

The manual is written by Dr Paige-Green, for The Committee of State Road Authorities, and is dated February 1990. (The copy supplied by ASIST is a DRAFT).

17.2. Proposed audience

The Preface states that: 'Technical Recommendations for Highways (TRH) are written for the practising engineer and describe current, recommended practice in selected aspects of highway engineering. They are based on South African experience and on the results of research and have the full support of the Committee of State Road Authorities (CSRA)¹⁸.

17.3. Aesthetics of manual

The manual is A5 in size and is a black and white photocopy of the original supplied by ASIST. The manual is a mix of text, diagrams and tables, although there is more text than diagrams. The manual has over 50 pages. The size of text is adequate and the font is bold and unserifed.

17.4. Structure of manual

The manual has a 'contents' page, a 'Preface', an 'Introduction', and a List of References, page numbers are used.

17.5. Scope of manual

The manual covers the following topics:

- Typical unpaved road defects
- Design of unpaved roads
- Construction
- Maintenance
- Rehabilitation and upgrading
- Economic aspects
- Appendix

The introduction gives an interesting view on where unpaved roads fit into the 'big picture' and the purpose of the manual: identifies design and construction techniques, recommendations for improving maintenance management, and appropriate maintenance techniques. Definitions of earth tracks, earth roads and gravel roads are given, but diagrams or photographs are not provided. The manual is intended for use with gravel roads generally carrying less than 200 vehicles per day, but could also be applicable to earth roads. The traffic on gravel roads is briefly discussed and some figures are mentioned. Basic economic principles applied to unpaved roads are specified and problems identified.

17.5.1. Typical unpaved road defects

The typical defects are listed as: dustiness; stoniness; corrugations; ruts; cracks; ravelling; erosion; slipperiness; impassability and loss of surfacing or wearing course. Each defect is detailed, a few diagrams and photographs are provided for the explanation of corrugations, but the other defects do not benefit from the addition of visual aids. An explanation of each defect is given, together with the possible problems it causes and in some cases a discussion of how to prevent the problem. The explanations are not supposed to allow the reader to go and survey the defects, they are merely a discussion around the subject.

¹⁸ TRH 20 - The structural design, construction and maintenance of unpaved roads, Committee of State Road Authorities South Africa, 1990, pi.

17.5.2. Design of unpaved roads

The section starts by stating that geometric design is not considered in any detail in the manual. Suggested widths of unpaved roads are given, which relate to traffic. The manual states that no 'scientific structural design procedure for unpaved roads is presently used regularly in South Africa'¹⁹. An equation for calculating the minimum thickness required to provide subgrade protection is given. A discussion relating to CBR and materials ensues. Traffic induced compaction and predicted annual gravel loss are also discussed.

Material selection – a specification for materials for unpaved rural roads is provided, based on: maximum size, oversize index, shrinkage product, grading coefficient and CBR. One is left wondering if the specification is perhaps too sophisticated for rural roads. A chart based on the shrinkage product and the grading coefficient then splits materials into erodible materials; those which ravel and corrugate; those which ravel; those which are good (but may be dusty) and those which are slippery. A further explanation of each zone on the chart is then given. A specification using the same factors is provided for urban unpaved roads and unpaved haul roads.

17.5.3. Construction

The section states that good preparation of the subgrade is very important, as the road may eventually increase in importance and require upgrading. Preparation of the subgrade is detailed, but no diagrams are used. Construction of the formation and drainage is also covered.

Gravel operations – 'Materials location is a science in itself and should follow a logical process and not the random exploration that is often done (Netterberg, 1985). The materials should be located by either experienced field staff or geotechnical experts.....'²⁰. Unfortunately however, rural roads do not always have the luxury of such experts to help source gravel. The discussion does not use any diagrams to help put across the points it tries to make. It gives advice to be followed, but little explanation on how actually to achieve the advice it gives. For example: 'One of the main problems with the construction of unpaved roads is the lack of supervision'²¹. The manual does not attempt to suggest how supervision could be improved, apart from suggesting that close supervision by experienced personnel is needed.

Wearing course construction – good construction practices for wearing courses are given. The importance of getting the thickness right is specified. The importance of compaction is stated and problems with poor compaction mentioned. The manual states that the roughness of a road is one of the most important factors influencing vehicle costs. It goes on to say - 'A good surface after construction can be maintained to a much better standard than a poorly finished surface'²². The manual warns of rolling in oversize material, as it can cause rapid deterioration.

Drainage – the manual discusses the problem of surface water and sub-surface water to an unpaved road. It explains the meaning of each and what the drainage can do to help. Diagrams of ditches and drains are provided.

17.5.4. Maintenance

Maintenance management systems should provide answers to the following questions²³:

¹⁹ TRH 20 - The structural design, construction and maintenance of unpaved roads, Committee of State Road Authorities South Africa, 1990, p15.

²⁰ TRH 20 - The structural design, construction and maintenance of unpaved roads, Committee of State Road Authorities South Africa, 1990, p23.

²¹ TRH 20 - The structural design, construction and maintenance of unpaved roads, Committee of State Road Authorities South Africa, 1990, p24.

²² TRH 20 - The structural design, construction and maintenance of unpaved roads, Committee of State Road Authorities South Africa, 1990, p26.

²³ TRH 20 - The structural design, construction and maintenance of unpaved roads, Committee of State Road Authorities South Africa, 1990, p29.

Required budget?
 Staff and equipment required?
 Frequency of operations?
 Resultant level of serviceability achieved?
 Volume of gravel to be replaced annually?
 Which roads should be upgraded?

The MDS (Maintenance and Design System) is explained and is suggested as being suitable for the management of operations on unpaved roads. Levels of serviceability are related to the traffic. The manual states that no guidelines on the level of serviceability exist, but a table of definitions of serviceability is provided. Routes, which are important for reasons such as fragile product movement etc, do not fit into the classifications that rely solely on traffic levels. The table gives levels of serviceability from 1-6, against maximum roughness, dustiness and impassability.

The manual suggests that cost effective maintenance is the key to successful maintenance. Maintenance is split into roadside, drainage and surface. Each of the three types of maintenance is defined and the activities briefly described. The descriptions would not allow the reader to go out and supervise the activities without additional guidance, as the descriptions are nothing more than an overview of what types of activities are important. Surface maintenance of unpaved roads is said to be the main cost factor of maintenance. Some 2.5 pages is given over to a discussion of grader blading. The discussion is interesting, but again, is not of sufficient detail to allow the reader to obtain a good understanding. The manual obviously assumes a certain level of knowledge exists. Regravelling and spot regravelling are also dealt with in a similar manner, although each receives only half a page of discussion. Reworking and compaction of existing gravel is also briefly mentioned. Safety aspects are mentioned to try and draw attention to the fact that unpaved roads often have poor safety records because of the nature of the site and the work. The manual does not try to advise on safety, merely draw attention to the problem.

Cost effectiveness of maintenance – 'The roughness of the road is the major controllable factor affecting the vehicle operating costs on that road. Maintenance is the only means of reducing the roughness and is therefore directly related to the vehicle operating costs'²⁴. An example of the effect of programmed maintenance is given, to demonstrate the savings possible. A check-list of data required for an MMS is provided in the appendix. For example: Link identification should include region, district, road number, kilometre points, length, and required level of serviceability.

17.5.5. Rehabilitation and upgrading

A definition of rehabilitation is provided and a short discussion as to the meaning of maintenance and rehabilitation is undertaken.

17.5.6. Economic aspects

Economic analysis is not described, however a chart is provided which shows the relationship between average road roughness and total vehicle operating costs. The section also looks briefly at the issue of upgrading a road, and the aspects which should be considered.

17.5.7. Appendix

Recommended test method for a grading analysis of unpaved road wearing course material
 BASIC listing of model to predict annual gravel loss and regravelling frequency
 BASIC listing of model to predict change of roughness with time and blading frequency
 Checklist of maintenance management input requirements

²⁴ TRH 20 - The structural design, construction and maintenance of unpaved roads, Committee of State Road Authorities South Africa, 1990, p38.

17.5.8. General observations

The manual seems to be written for engineers from developed countries to advise of the situation in developing countries. It is a manual which is quite technical in places, assumes a certain level of knowledge and does not explain the procedures it discusses. It covers the issues of importance, but in many cases it is just stating the issues rather than explaining them in any detail.

A “this is what should be done” manual, in reality it is perhaps too sophisticated for the level of roads it aims to advise on.

18. MANUAL ON IMPROVEMENTS/ MAINTENANCE OF PATHS. MAKETE INTEGRATED RURAL TRANSPORT PROJECT SELVARASA, K TANZANIA

18.1. General Information

The manual is written by K. Selvarasa, and is dated June 1992.

18.2. Proposed audience

The Introduction states that: 'This manual presents in a simple and understandable form, the methods of improvements and maintenance of paths using locally available resources. However proper solutions for specific problems should be found by the gang leader/ foreman on site using this manual as a guideline'²⁵. One can therefore assume that the audience is a gang leader or foreman. Further on in the manual it states that the project has trained gang leaders, and the manual should allow them to address the problems with which they are faced.

18.3. Aesthetics of manual

The manual is A4 in size and is a black and white photocopy of the original supplied by ASIST. The manual is a mix of text and diagrams, (some hand drawn sketches). The manual has approximately 20 pages. The size of text is adequate and the font is unserifed.

18.4. Structure of manual

The manual has a 'contents' page, and an 'Introduction', page numbers are used.

18.5. Scope of manual

The manual covers the following topics:

- Present condition of paths

- Hand tools

- Improvements

- Drainage

- Steepness

- Water crossings

- Invading vegetation and narrowness

- Maintenance

The introduction (as already quoted) explains the purpose of the manual.

18.5.1. Present condition of paths

The problems with the paths are specified and split into those constituting a major problem and minor problem: Major = drainage, steepness and water crossings. Minor = narrowness and invading vegetation. The section states that major problems require improvement and then maintenance and minor problems require only maintenance.

18.5.2. Hand tools

A list of hand tools necessary for path rehabilitation and maintenance is provided.

18.5.3. Improvements

The section states that no drainage provision is currently made.

²⁵ Manual on improvements/ maintenance of paths, Makete integrated rural transport project , Selvarasa, K, Tanzania, 1992, p1.

18.5.4. Drainage

Advice is given on surface shaping, and then a construction procedure, with diagrams, for shaping the path is given. Diagrams and instructions are provided for constructing a camber. Cross drainage in the form of water bars and drainage dips are introduced, diagrams and instructions for construction are provided.

Sub-surface drainage is covered next in the form of bush culverts, rock drains, catch water drains, anti-slip surfaces and side erosion control. Descriptions, diagrams and instructions are provided.

18.5.5. Steepness

Relocation or a zig-zag alignment is an option put forward to overcome the problem. The addition of steps is specified, demonstrated with a diagram and construction details are given. Wooden steps, stone steps and soil steps are mentioned and depicted.

18.5.6. Water crossings

The materials required to construct a footbridge are specified and as before, a diagram and construction details are provided. Access over marshy areas can be achieved using rafts and turnpikes, both of which are depicted and construction details provided.

18.5.7. Invading vegetation and narrowness

The problem of overgrown bushes etc is mentioned, and the manual advises maintaining a minimum clear width of 1m.

18.5.8. Maintenance

This section is surprisingly brief considering the detail which was provided in the previous sections. The purpose of path maintenance is stated and the activities are classified into either routine or periodic using a table to split the activities. For example: the path element relating to drainage – cross drainage – water bar = the routine maintenance is clean/ remove debris silt etc and the periodic maintenance is the replacement of logs and plugs if rotten. The information is therefore quite sparse and no diagrams or step by step instructions are provided.

18.5.9. General observations

The manual covers a very specific area – paths. Yet it does so quite effectively. The step by step instructions and accompanying diagrams are perfectly acceptable and useful. It is a shame that maintenance is not covered in any detail, and one gets the impression it was just tagged on the end as an after thought. The manual could easily be slotted in as a chapter in a larger manual.

A “what to do and how to do it” manual.

19. SAETRUM, P HANNA NASSIF - COMMUNITY DEVELOPMENT PROJECT - MANUAL ON MAINTENANCE AND DRAINAGE OF ROADS, TANZANIA.

19.1. General Information

The manual is written by Pal Saetrum as part of the community project. However it does not state whether donor aid was involved. The manual is however quite new (1997). 'This maintenance manual is designed to serve the community of Hanna Nassif as a guideline to use fully the possibilities of labour-based road and drainage maintenance, and to use the local resources available'²⁶.

The manual refers to the sections of road which have been rehabilitated as having a higher maintenance priority. It acknowledges that inadequate resources should not be spread over the whole area. The area apparently suffers drainage problems, due to the very narrow streets, which do not allow drainage of a standard design to be provided.

The following interesting statement is made: 'Normally a smooth road is considered as an advantage to allow high traffic speed and low vehicle operation cost. In this special case of Hanna Nassif the opposite is desired. Distances are under 1km, so low speed has little cost implication for vehicle operation and time cost. Traffic safety in the area will not allow for speed above 15-20 km per hour'²⁷.

The manual states that heavy machinery is not an option, and points out that the daily hire of a motor grader would pay 200 labourers for a day! Employment is necessary within the community and the manual points out that it is important for wages to remain within the community. The manual states that the salary for a foremen carrying out site supervision should be an overhead.

19.2. Proposed audience

The proposed audience does not appear to be stated, however one would imagine that a supervisor or foreman would benefit from the manual.

19.3. Aesthetics of manual

The manual is a black and white photocopy from ASIST. The manual has over 60 pages, the text is reasonably large and is a serified font. The manual is easy to read, with reasonably short paragraphs, bullet points, diagrams, and sketches. The English is generally OK.

19.4. Structure of manual

The manuals contain a 'Contents', and a 'Project History', an 'Abbreviations list' and a 'Glossary'. The main headings are split into numbered sub-headings and the Annexes are also numbered. Some of the diagrams and graphs etc. are numbered, but some are not.

The length of the chapters seems reasonable and the pages are numbered. The manual does not contain a reference list or a bibliography. Blank forms and activity standards form part of the Annexes. The sheets could easily be copied and used.

19.5. Scope of manual

The contents of the manual are as follows:

19.5.1. Maintenance:

Introduction

The purpose of Road Maintenance (States the purpose for Hanna Nassif).

²⁶ Saetrum, P Hanna Nassif - Community Development Project - Manual on maintenance and drainage of roads, Tanzania, p4.

²⁷ Saetrum, P Hanna Nassif - Community Development Project - Manual on maintenance and drainage of roads, Tanzania, p5.

Maintenance needs (States the needs in Hanna Nassif - Drainage to be clean and intact and roads to allow access to traffic).

Choice of technology (Explains why labour should be used instead of machines, some hire charges for a local workshop are given to demonstrate the hiring equipment is not an option for the community.).

Mechanisms of deterioration and failure of roads (Names them, but no further info).

Failure of roads (Names the types of failure)

Interestingly, no diagrams are used to back up the points being made. Rather surprising as the manual is simplistic in its approach.

19.5.2. Maintenance systems:

Routine maintenance 'Small scale operations with limited resource requirements carried out at regular intervals'.

Periodic maintenance 'Operation requires extra resources, and are carried out at intervals up to seven years'.

Emergency maintenance, spot improvement. '...to repair sudden unforeseen damage ...impossible to plan these activities.'²⁸. It does however state that 10-20% of the routine maintenance budget should be put by for urgent problems. The manual also refers to 'intermediate maintenance (spot improvement)'. The explanations are therefore quite limited.

19.5.3. Maintenance management:

Planning (It states that estimation of funds for the full year should be carried out using Annex 1 and then the maintenance activities should be ranked according to importance using Tables 1 -6). (Detailed under Annexes). Under funds, the manual states that 150,000 TZS per month can be used for routine maintenance. A graph of rainfall covering 10 years is given in the Annex and it is stated that the rainfall chart should be used to plan maintenance. A table is provided which lists and describes routine maintenance activities. The following comment under Resources and Utilisation is of interest: 'If funds run out before all activities have been completed in a season, you may have to stop work before time, but always try to follow the priorities'²⁹. The forms to be filled in weekly and monthly by the foreman are stated and are contained in Annex 3.

Execution of work - This section refers to using different trained teams to carry out specific tasks. 'By giving out well defined task work the jobs should also attractive among the hardworking people who should be recruited'. It states that the tools for staff should be of good quality. 'With good tools high productivity can be achieved..³⁰. The tools and materials required are listed. Piecework contractors are mentioned as a worthwhile progression for the staff who have gained some experience. Lump sum or piecework contracts could be used. A contract form is provided, to be used only for small contracts.

Contracting - A very interesting section which points out the disadvantages of contracting out to contractors who are outside the community of Hanna Nassif. It quotes: '...negative effects by using outside contractors could be: Community do not feel the ownership to the project anymore'³¹. The positive effects of employing from within the community are then given. It

²⁸ Saetrum, P Hanna Nassif - Community Development Project - Manual on maintenance and drainage of roads, Tanzania, p8.

²⁹ Saetrum, P Hanna Nassif - Community Development Project - Manual on maintenance and drainage of roads, Tanzania, p11.

³⁰ Saetrum, P Hanna Nassif - Community Development Project - Manual on maintenance and drainage of roads, Tanzania, p12.

³¹ Saetrum, P Hanna Nassif - Community Development Project - Manual on maintenance and drainage of roads, Tanzania, p15.

states that rehabilitation contracts, which are of a larger extent, will need to be contracted out under a different procedure.

Reporting and monitoring - Weekly forms are used for reporting and the information is then checked and transferred to the Monthly/ Quarterly form where the expenses are recorded. The totals are transferred to the yearly form.

Assessment of maintenance requirements: It states that immediately after rehabilitation or construction, the routine maintenance should be started in a planned way. Using the inventory, all the sections should be inspected and given priorities. 'By spending 400-500 Person days per km in a year effectively, there will be no excuse not to keep the roads in good shape'³².

Maintenance priorities - Maintenance of drainage forms > 70% of the total maintenance and priority should always be given to drainage. (Attention is also drawn to seasonal priorities).

Maintenance work plans – talks very briefly of the different levels of work days needed at different times of the year and refers to a table.

Training in maintenance of roads - refers to how important training is for the site supervisor.

19.5.4. Maintenance of structures and drains:

Maintenance of structures - It states that the structures are important and expensive. It states that periodic maintenance will have to eventually replace the timber structures with concrete. The supervisor/ inspector should keep in mind the condition of the structures, a reference to the map location on a strip map should be made. The supervisor must be fully up to date with the number of structures he has and there type and location etc. The structures should be grouped as follows: 'Structures that never cause problems, Structures that require constant maintenance, Structures that cause problems at the time of rain'³³.

Maintenance of drains - Urgent maintenance may be necessary, it is difficult to plan. The planning involves having fund and tools available at short notice. The typical activities are listed but are not explained.

Periodic maintenance activities - The activities, code and report unit are given, for example: 'Code RM1, Unit M, General inspection and removal of large obstructions in the drain system'³⁴. However, diagrams and detailed explanations are not provided for each activity mentioned.

Organisation of management: very brief statement that the management (of maintenance) would normally undertaken by the Chairman and Secretary of CDC, assisted by the cashier, storekeeper and foreman³⁵.

Maintenance staff - 'Site Supervisors/ Foreman, Cashier/ Accountant, Storekeeper, Plumber, Mason, 3 -4 Teams with 4 people'³⁶.

Typical maintenance activities – a diagram giving an example of a typical activity with warnings. Lacking in detail!

³² Saetrum, P Hanna Nassif - Community Development Project - Manual on maintenance and drainage of roads, Tanzania, p17.

³³ Saetrum, P Hanna Nassif - Community Development Project - Manual on maintenance and drainage of roads, Tanzania, p19.

³⁴ Saetrum, P Hanna Nassif - Community Development Project - Manual on maintenance and drainage of roads, Tanzania, p21.

³⁵ Saetrum, P Hanna Nassif - Community Development Project - Manual on maintenance and drainage of roads, Tanzania, p22.

³⁶ Saetrum, P Hanna Nassif - Community Development Project - Manual on maintenance and drainage of roads, Tanzania, p22.

19.5.5. Annexes:

Graphs and maps - Maintenance costs, Rainfall, Blank Road Inventory sheet, Example of a strip map.

Tables and forms - Example of inventory, Table showing costs for one year (activities for one year); Table showing the estimated distribution of work days per km or road per year 97/98; Activities for one year, activities covered under routine maintenance (before rains and during rains, end of rains); agreement form for small contract works; Weekly, monthly/ quarterly and yearly site report sheet; road workshop hire charges.

Cross-sections and templates - reduced cross section with side slopes, with one side slope, emergency repair planner.

Activity sheets - Maintenance activity standards for activities RM1 - RM 10, gives description, diagram, typical workforce, materials required, tools required, remarks, task rates etc. Probably the most useful part of the manual and similar to those included in the Maintenance Management Manual for Ghana. Also, emergency maintenance standards, and periodic maintenance standards.

19.5.6. General observations

This manual actually contains a lot of information, the activity standard sheets are useful. The main body of the manual would benefit from the addition of more visuals to explain the points more effectively. In some ways the manual is quite simplistic, yet it does not explain the points in sufficient detail for it to be a stand alone manual, one must assume that the missing information is located elsewhere. For example: various maintenance activities are named, yet they are not described in enough detail to allow them to be undertaken. Blank forms are provided, but examples of how to fill in the forms are not given. The manual is supposed to serve the community, yet it is almost aimed at a higher level

A “this is what you should do and what you should consider” manual.

20. ROAD MAINTENANCE MANAGEMENT GUIDELINES MOWTC UGANDA

20.1. General Information

The manual is produced by the Ministry of Works, Transport and Communications, and is dated 1993.

20.2. Proposed audience

The proposed audience is not stated. As the manual relates to labour based contracts, the audience will probably be anyone involved in such work from the MoWTC, (which could be District Engineer, Supervisor or Foreman). The manual is based on a mix of text and tables.

20.3. Aesthetics of manual

The manual is A4 in size, and is a photocopy of the original provided by ASIST. Therefore the style in which the manual will eventually be published is unknown. The manual has approximately 60 pages, which are numbered. The text is reasonably large and the font is serifed.

The quantity of visuals to text is low. The manual appeared on shelf of all the staff interviewed in Uganda.

20.4. Structure of manual

The manual has a 'Contents', and a list of Annexes, (which actually take up 4/5 of the manual).

20.5. Scope of manual

The manual is split into sections on labour based work and force account operations. The annexes contain a significant amount of information, in particular a good selection of work method statements for various maintenance activities.

20.5.1. Labour based contracts

Introduction – specifies when the contracts should be made and what the contract should include.

Packaging of work – the length of road to be covered, a short discussion on frequency, the forms to be filled in and how to calculate the price.

Engagement of contract – covers the procedure to be undertaken.

Contracts – who the contract will be signed between and the forms.

Supervision – a list of responsibilities for the District Engineer, Supervisor and the Road Overseer. A few lines on the measurement of the work and a list of obligations for the Contractor. Advice on how the mode of payment should be dealt with.

Monitoring – a list of which members of staff of required to make what type of report and when.

20.5.2. Force account operations

Road maintenance operations – for routine and periodic maintenance, a list of production targets are stated (as per day & per month targets).

Routine manual maintenance, routine mechanised maintenance and periodic maintenance – a short discussion relating to each which states the basis for carrying out the work.

Cost accounting – states the daily records that should be kept, and states the forms which must be filled in as part of the procedure.

Monitoring – the monitoring mechanism is specified with regard to the staff responsible.

Proposed performance allowances – what to pay and when to pay it is covered.

Fuel issues – states that fuel will be issues according to equipment in service, and will be subject to a reporting procedure.

Conclusion – the manual is for guidance only and applies to all road maintenance projects.

20.5.3. Annexes

- Packaging of work
- Packaging summary
- Prequalification form
- Contract
- Bill of quantities
- Specification
- Blank work plan and similar forms

Work method statements (similar to activity sheets) which contain the following information: activity, priority, road type, definition of work, manpower, standards and specifications, tools, safety signs, materials, work method, special considerations, method of measurement and average daily production.

A number of blank monthly forms

A list of roads to be maintained by labour contracts

20.5.4. General observations

The guidelines are effective in that necessary information is given to complete the tasks indicated. The activity sheets are effective and a good selection of blank forms are provided. Despite the fact the title of the manual is 'guidelines' the impression one gets from reading the text is that the staff involved would be expected to follow the instructions quite closely. The reason for this is the use of the word 'will' in the text.

A "these are the guidelines and this is what you should do to comply" manual.

21. DRAFT MAINTENANCE MANUAL MOWTC UGANDA

21.1. General Information

The manual is produced by the Ministry of Works, Transport and Communications, and is a DRAFT dated 1998. Due to the fact the manual is a draft, it is unfortunately incomplete. However, the sections that are present are worthy of review. The introduction is not yet available. However, the document appears to be a working document for the MoWTC, and will presumably be available to all staff.

21.2. Proposed audience

The proposed audience is not stated. However, the manual is likely to be of interest to all staff of the MoWTC. The manual is based on a mix of text and tables.

21.3. Aesthetics of manual

The manual is A4 in size, and was printed from a disc provided by the staff at the MoWTC. Therefore the style in which the manual will eventually be published is unknown. The manual has over 120 pages in its present form, which are numbered. The manual has 13 chapters, which are listed at the front of the document in the 'Contents'. The text is reasonably large and the font is serifed.

The quantity of visuals to text is low at present, however as the manual is in a draft form, it is likely that more visuals may be added at a later date. The manual has the feel of a book which would stay on the engineers shelf for reference, rather than a manual which would be 'dirtied' in the field. It is a large document, and not exactly a 'pocket reference' manual.

21.4. Structure of manual

The manual currently contains a 'Contents', it should eventually have an introduction but has not got one yet.

21.5. Scope of manual

The manual is split into the following chapters:

- Introduction (not present)
- MoWTC organisation (organisational chart not present)
- MoWTC maintenance policy
- Road safety
- Road reserve
- Environmental issues
- Uganda Highway Maintenance Management System (UHMMS)
- Methods of work
- Force account operations
- Maintenance contracts
- Reporting
- Management of stores
- Management of equipment

21.5.1. MoWTC organisation (organisational chart not present)

The length of the road network is stated. A standard list of roads which the MoWTC are responsible for has been established, and a database of road links has been set up. The MoWTC operates through Maintenance Stations operated by District Engineers. A digitised GIS map of Uganda has been developed.

21.5.2. MoWTC maintenance policy

'Objectives of road maintenance is to provide safe, efficient all-weather access on all links of the road network, postpone the date when rehabilitation or reconstruction will be due, protect the investment and support economic activities'³⁷. The priorities for the road network are stated as: the primary road network (AADT>1000), other key links on the primary road network, key links on the secondary road network (AADT> 200), and then all other roads. The manual states that the manual routine maintenance should be carried out by lengthmen, force account operations should be limited to mechanised routine maintenance, (but this will be increasingly contracted), periodic/ rehabilitation/ reconstruction will be undertaken by contractors, emergency maintenance will be executed by force account operations.

21.5.3. Road safety

The manual states that the following factors are causes of road accidents in Uganda: narrow shoulders, lack of road markings etc, potholes, poor drainage and tight bends. The reasons for traffic management at road works are stated and advise on selecting and placing temporary signs is stated. (The sign layouts and sign diagrams will be added to the manual in due course). The reader is also directed towards the MoWTC General Specifications for Road and Bridge Works for information on diversions, signs etc.

21.5.4. Road reserve

The importance of safeguarding the road reserve against encroachment is stated. (This section is incomplete).

21.5.5. Environmental issues

This chapter covers the issue of: water management, soil conservation, sand encroachment, protection of vegetation, and village roads. Institutional aspects are dealt with first and the parties involved in maintenance are specified. The main types of road maintenance contract are then listed. The manual states that certain clauses should be included in road maintenance contracts which take account of the road environment, and the points requiring focus are listed. Technical aspects looks at the fact that norms and standards should be adopted which give consideration to environmental issues. Water management lists the methods for dealing with roadway water. Soil conservation looks at roadway and embankment soil and ditches. Maintaining vegetation is covered. Passage through villages looks at precautions during works and permanent improvements. Borrow pit reinstatement is also mentioned. The detail given is not very great, for example, the paragraph on ditches talks of creating additional turnouts, reduction of the lengthways slope, planting grass or stone lining. No diagrams or instructions are provided. The manual is therefore advising on what needs to be considered rather than specifying how to actually undertake the work itself. (The section is incomplete).

21.5.6. Uganda Highway Maintenance Management System (UHMMS)

The chapter states that the MMS uses assessment, prioritisation and economic evaluation models (based on HDM III methodology). The results achieved with the system are only as accurate as the data that it uses. The network database stores the inventory data, the traffic database stores the traffic data and predict the traffic growth rates. Construction data and maintenance standards are also stored. An explanation of what the system is able to calculate is provided.

Guidelines on collecting inventory and condition survey data are provided to ensure the data from the districts is in the same format for entering onto the database. The resources required to collect the data are given, the principles of the inventory survey are given and feature codes are provided, blanks inventory form and an explanation of how to fill it in. Principles of the visual survey, a list of condition survey defect ratings, a condition survey form, and an explanation of defect levels. (The section is incomplete).

³⁷ DRAFT Maintenance manual MoWTC Uganda, 1998, p6.

21.5.7. Methods of work

Standard MoWTC maintenance terminology is given for routine, periodic and emergency maintenance. The road maintenance specifications are then given for all activities – no diagrams are used to demonstrate the points being made. For example, the specification for the cleaning of streams, channels and other water courses is as follows: 'All debris and vegetation shall be suitably removed from within the streams, channels and other water courses such that they remain clean and free flowing at all times, and all cleared spoil and other arisings shall be suitably disposed of at least 25 metres distant from the road centreline. All without damaging the road formation pavement or structures adjacent public/private property in any way and all to the satisfaction of the employer'³⁸. For some of the items, a method of work and measurement and payment advice is given. Both labour based and mechanised activities are covered for roads and drainage works. Some of the descriptions are quite lengthy, and would probably have benefited from the addition of some visuals.

21.5.8. Force account operations

A short discussion on the choice between labour based and mechanised maintenance is undertaken, and also the issue of force account and contracting. A list of activities and their potential for equipment and labour based completion is provided.

21.5.9. Maintenance contracts

The issue of routine manual maintenance contracts is discussed first, this includes the packaging of the work, procurement of contractors, supervision, measurement, mode of payment, and monitoring. Next the mechanised maintenance contracts are discussed and this includes surveys, fixed unit rate contracts, standard contract document, and local competitive bidding. (This section is incomplete).

21.5.10. Reporting

The management considerations to be considered as part of the reporting procedure are listed. The required contents of the report is then listed, together with advice on monitoring and evaluation, auditors, and the donors involvement. Quality control is mentioned as it ensures that investments in construction and maintenance are used efficiently. A list of the conditions which are the means by which the condition of the road is assessed are given. They are the means by which the quality of work can be checked. The reader is also pointed to the MoWTC General Specifications for Road and Bridge Works.

21.5.11. Management of stores

A list of forms is given which are required in the management of stores. The forms themselves are not included and the section is incomplete.

21.5.12. Management of equipment

The purpose of the mechanical services section is stated. The organisational structure is briefly mentioned, its functions have not yet been included, a brief mention of the quantity equipment (but not in any detail), a discussion relating to the obligation to provide ferries, other functions of the section. The maintenance of the equipment is specified as preventative maintenance, which is then split into routine, planned, condition based and break-down maintenance – the meaning of each is then detailed. The Management Information System (MIS) is discussed, it is apparently in the process of being set up, and will include a database of parts, equipment and tools, costing functions, schedules, a library and reporting. Performance indicators are listed under the headings of operational, technical, financial and labour. The remainder of the section is incomplete but lists operational strategies, programs, constraints, and remedial measures.

³⁸ DRAFT Maintenance manual MoWTC Uganda, 1998, p47.

Annex 1 is provided (the others are probably not complete yet), it contains a list of the classified road network split into: the station responsible, link number, link name, road number, start and end km, class and length.

21.5.13. General observations

When the manual is finished it will be quite a large document. It is definitely lacking in visual aids at present, but that may be due to the fact it is not complete at present. It is a manual which is perhaps filling in the gaps of the General Specifications for Road and Bridge Works. It tends to state what should be done, but does not necessarily explain how to do it. It is the type of manual one would expect to be produced by a government body, one that contains the information but does not have anything to encourage the reader to take in the points it aims to put across. One could imagine a new employee being told to go and read it as part of their induction.

A “this is what should be done” manual.

22. OVERSEAS ROAD NOTE 1 (MAINTENANCE MANAGEMENT FOR DISTRICT ENGINEERS) OVERSEAS UNIT TRL

22.1. General Information

The manual is produced by the Overseas Unit at TRL and is dated 1987. The introduction explains that the 'Note is a practical guide to the management of maintenance operations. It outlines a rational approach that will help maintenance engineers organise and control the activities for which they are responsible, so as to improve efficiency and make more productive use of maintenance resources'³⁹. Whether or not the note is available in languages other than English, is not stated.

22.2. Proposed audience

The proposed audience is the maintenance engineer. However, the manual is likely to be of interest to a wider audience and is one of the best known documents of its kind. The manual is based on a mix of tables, figures, graphs, diagrams and photographs. The document is not in colour.

22.3. Aesthetics of manual

The manual is A4 in size, with cardboard front cover in colour. The manual has 64 pages, which are numbered. The manual has 11 sections (chapters), which are listed at the front of the document in the 'Contents', together with a reference page and 'Appendices'. The text is small and the font is serified.

The quantity of visuals to text is reasonably high, with most pages having at least a table or diagram. Black and white photographs are used in Appendix E to good effect. Annotation is used. The manual has the feel of a book which would stay on the engineers desk for reference, rather than a manual which would be 'dirtied' in the field.

22.4. Structure of manual

The manual is set out in the normal style for a TRL document and contains an 'Acknowledgements', 'Contents' with page numbers, 'References', 'Appendices', and information on where to obtain copies of the manual. Blank sheets are provided, which could easily be photocopied. There is a good mix of text and visuals, and visuals are numbered.

22.5. Scope of manual

The manual is split into the following sections:

- Introduction
- The role of the maintenance engineer
- Maintenance activities
- Management tasks
- Inventory
- Inspection
- Determination of maintenance requirements
- Resource estimation
- Identification of priorities
- Work scheduling and execution

Monitoring

³⁹ Overseas Road Note 1, Overseas Unit, TRL, 1987, p1.

22.5.1. Introduction

The introduction states that maintenance operations only are dealt with. It also states that model systems are not defined, this is because the management system should match the organisation, conditions etc and be appropriate to the situation.

22.5.2. The role of the maintenance engineer

The benefits of a well maintained road system are specified. Five management responsibilities of the engineer are listed, (forms the basis for the sections on management tasks). The reasons why site visits for the engineer are important are stated. Delegation, training, the use of computers and implementation are briefly mentioned in an advisory way – to promote thought.

22.5.3. Maintenance activities

The usual method of categorising maintenance activities by their frequency is specified. With each being briefly defined. Examples of activities which appear under each activity are given. The manual states that routine maintenance should be treated as a fixed-cost item and recurrent and periodic as variable-cost items.

22.5.4. Management tasks

The structuring of the following activities: Inventory; Inspection; Determination of maintenance requirements; Resource estimation; Identification of priorities; Work scheduling and execution; Monitoring, forms the programme for the maintenance engineer.

22.5.5. Inventory

The definition of an inventory is given, followed by a list of what it should contain. Methods of presenting the data are suggested, and diagrams are used to demonstrate the point.

22.5.6. Inspection

The difference between gathering data for an inventory and inspection is pointed out. Frequency of inspection is suggested, along with a two stage approach for condition surveys. Recording of results is also covered and some examples of forms (partly completed) which could be adopted are provided.

22.5.7. Determination of maintenance requirements

A grading frequency chart is provided to gauge the frequency of grading operations, an alternative method which requires a computer is also given in the appendix. Dragging and regravelling are also briefly mentioned. A method of monitoring the effectiveness of recurrent maintenance is suggested. A table gives maintenance intervention levels for unpaved roads. The discussion then turns to intervention levels for paved roads, which includes a large table, and paragraphs on diagnosing the cause of deterioration and specifying the work required.

22.5.8. Resource estimation

The choice between manual work and equipment based procedures is discussed in some detail and a table assessing the potential for the use of the two methods for a range of activities is given. A useful table lists the outputs of work which can be expected for different activities. Resource allocation is then discussed, and a partly filled in form demonstrates how to calculate the resource requirements.

22.5.9. Identification of priorities

When resources do not meet requirements, some method of prioritisation is required. The method of categorising maintenance activities by importance and roads by order of importance is explained and the matrix of maintenance priorities is introduced. The engineer is reminded to consider local conditions. The work programme can then be developed using the resource allocation forms and the priority matrix method.

22.5.10. Work scheduling and execution

Schedules must be prepared by the engineer for the benefit of the foremen, so that they know the quantity of work expected each day as part of the programme. A partly completed worksheet demonstrates how the target work and achieved work can be compared.

22.5.11. Monitoring

Monitoring includes inspection and desk review. The engineer is advised to become involved in inspections. The desk review involves looking at the documentation produced during the management process to assess performance.

22.5.12. Appendices A - E

Field procedures for inventory and condition measurement surveys – advice and instructions on how to undertake the tasks.

Management of grading for unpaved roads – a method to determine optimum grading frequency is described.

Traffic counting – an explanation of the purpose and procedures involved.

Recommended standard forms – blank for copying.

A good selection of photographic illustrations of typical defects.

22.5.13. General observations

The manual gives good coverage of each topic, the only areas which are not covered are: how to actually carry out the maintenance activities themselves, how to rate and assess defects (it does cover it, but not in sufficient detail), causes of defects and financial aspects, material sources and traffic control. The manual is effective and strikes a good balance between advice, instruction and demonstration. It does not always define how tasks should be carried out, but this is because it wants to help the engineer to adapt the methods to his own situation. The information is obviously generic, but despite that fact, some of the manuals produced for use in specific countries have obviously adopted the information direct from the manual.

It is a “this is how you could do it, and here are some examples” type manual.

23. OVERSEAS ROAD NOTE 2 (MAINTENANCE TECHNIQUES FOR DISTRICT ENGINEERS) OVERSEAS UNIT TRL

23.1. General Information

The manual is produced by the Overseas Unit at TRL and is dated 1985. The introduction explains that the 'Note describes the principle techniques that will be used to maintain roads within a District in a developing country. Particular attention is paid to the planning and design aspects of the work, as it is this area that the engineer will make the largest contribution. Practical execution is not described in detail'⁴⁰. Whether or not the note is available in languages other than English, is not stated.

23.2. Proposed audience

The proposed audience is the district or maintenance engineer. However, the manual is likely to be of interest to a wider audience and is one of the best known documents of its kind. The manual is based on a mix of tables, figures, graphs, and diagrams. The document is not in colour.

23.3. Aesthetics of manual

The manual is A4 in size, with cardboard front cover in colour. The manual has 44 pages, which are numbered. The manual has 7 sections (chapters), which are listed at the front of the document in the 'Contents', together with a reference page and 'Appendix'. The text is small and the font is serified.

The quantity of visuals to text is reasonably high, with most pages having at least a table or diagram. Annotation is used.

As with ORN 1, the manual has the feel of a book which would stay on the engineers desk for reference, rather than a manual which would be 'dirtied' in the field.

23.4. Structure of manual

The manual is set out in the normal style for a TRL document and contains an 'Acknowledgement', 'Contents' with page numbers, 'References', 'Appendix', and information on where to obtain copies of the manual. Blank worksheets are not provided in this manual, (unlike in Volume 1), however, a blank page for notes appears at the back of the manual. The visuals are numbered.

23.5. Scope of manual

The manual is split into the following sections:

- Introduction
- Methods of undertaking maintenance
- Safety measures and traffic control
- Maintenance of road furniture
- Maintenance of drainage, shoulders and slopes
- Maintenance of unpaved road
- Maintenance of paved roads

23.5.1. Introduction

The engineer's responsibilities are discussed and the possible impact he can make is emphasised. 'If there is one single factor which influences the standard of road maintenance more than all others, it is the attitude of the engineer responsible'⁴¹. The work of the engineer is split into 3 categories: assessment, allocation and monitoring.

⁴⁰ Overseas Road Note 2, Overseas Unit, TRL, 1985, p1.

⁴¹ Overseas Road Note 2, Overseas Unit, TRL, 1985, p1.

23.5.2. Methods of undertaking maintenance

The discussion of the merits of using labour based or equipment based methods is discussed again and the same table used (from OSRN 1) to look at the potential for different activities.

23.5.3. Safety measures and traffic control

Standard signs are depicted, and the principles of traffic control are discussed. The types of maintenance work are split into four types of activity with regard to their potential effect on traffic – work which does not encroach on the carriageway, work requiring a partial closure, centre line working, work requiring road closure. The signs to be adopted for edge working, lane closure, centre line working and diversions are listed.

23.5.4. Maintenance of road furniture

The purpose of signs is given, together with advice on how to look after them. Similar paragraphs then appear for rails and posts, and lines and studs. Personnel, vehicles and equipment for road furniture gangs and lining gangs are specified.

23.5.5. Maintenance of drainage, shoulders and slopes

The purpose of the drainage system is defined, an explanation of side drains, fords and drifts, culverts, bridges and slopes is provided. Some diagrams are used, but more diagrams would have been even better. A table of turnout spacing is provided. The personnel, vehicles and equipment required for a maintenance gang dealing with drainage features, shoulders and slopes is specified. The types of problems (defects) which are detailed in the text are those depicted in the photographs in the appendix of volume 1. They should perhaps either be placed next to the text in this volume or at least appear in both manuals, as it cannot be assumed that the engineer will definitely have access to both manuals. Sketches to demonstrate the methods explained would also have helped.

23.5.6. Maintenance of unpaved road

The types of maintenance are introduced. Firstly the types of grading – light and heavy are explained. Attention should be paid to the crossfall and the use of camber boards is depicted. Grader operation is then discussed, and the engineer is advised to refer to illustrated grading manuals to familiarise himself with the operations. The grading operation itself is explained and also depicted. A brief discussion of the grader gang for heavy and light grading operations is undertaken.

Dragging and brushing – the purpose is specified. The design of the drag, brushing, method of operation and the dragging gang are covered and some diagrams of the equipment are provided.

Regravelling – the purpose of the task is explained. The quality of the gravel is then briefly discussed and tables specifying the grading and plasticity characteristics are provided. Guidance on the estimation of the plant required for gravelling is specified along with a production estimate. Advice on the spreading of gravel and compaction is given. It is suggested that continuous working, where the traffic management is moved along the road in sections is adopted. Filling and patching work is suggested as an alternative to the larger scale operations and some guidance on the procedure is given. Unfortunately no diagrams are provided. Dust prevention – the problem is discussed and remedial treatments put forward as: application of a seal, chemical stabilisation, application of waste materials, addition of water. The treatments are not discussed in any detail.

23.5.7. Maintenance of paved roads

The types of defects requiring maintenance are introduced to the reader, and then each maintenance activity is discussed: local sealing, crack sealing, patching (recommendations for patching materials are provided). Diagrams are not used to demonstrate the points being put forward, the text is based around what 'should' be carried out.

Mechanised surface dressing – the general principles are put forward. The design of the surface dressing is then discussed and takes into account the road surface types (a table is provided), traffic categories (a table is provided), chippings (a table of recommended chipping sizes, and condition constraints and a surface dressing design chart are provided), binder (table of surface temperature/ choice of binder), equipment and application (application of binder/ spraying temperatures (table provided), jointing strips, application of chippings, rolling, aftercare and control). The amount of detail is significant in comparison to all the other subjects covered in both Volume 1 and 2 or the manuals.

Manual surface dressing – the general principles covered under the mechanised section apply generally, but some additional advice is provided which is specific to the manual method. A table of instructions for the control of surface dressing is given, which is a list of step by step instructions. Advice of chippings, binder, application of chippings and binder, and rolling are given. Advice on the necessary gang size is also given. A short section on slurry sealing is also included, which provides an explanation of what it is, aggregate grading, slurry composition and coverage of the surface.

Appendix A - Additional notes on surface dressing are provided.

23.5.8. General observations

The manual gives plenty of detail on maintenance practices for unpaved roads, in a similar way to the IRMH, but using descriptive methods, backed up with some diagrams. The information given goes into greater detail than the IRMH, obviously because the manual is aimed at engineer level. The manual compliments Note 1, but does not appear to cover: how to rate and assess defects, causes of defects and financial aspects, and material sources. It covers traffic management and the choices to be made between direct labour and contract. It does however go into surface dressing in great detail, which is surprising. Some 14 pages of the manual are taken up with information on surface dressing, which does seem rather strange. Similar detail could have been supplied on the other topics covered. The manual would benefit from the addition of extra diagrams.

It is a “this is how you could do it, and here are some examples” type manual. Yet with regard to surface dressing, far more information is given.

24. PIARC - IRMH VOLUME II (MAINTENANCE OF UNPAVED ROADS)

The IRMH series are probably the most well known of all the maintenance manuals, produced by PIARC in 1994. There are four handbooks as follows:

Volume I - Maintenance of Roadside Areas and Drainage

Volume II - Maintenance of unpaved roads

Volume III - Maintenance of paved roads

Volume IV - Maintenance of Structures and Traffic Control Devices

Although consideration was only given to Volume II, it is worth noting that Volume I contains a useful 'List of Terms' for the whole series and also an Index, so one must assume that a person using Volume II, would also need Volume I.

24.1. General Information

The Handbooks are a revision of the United Nations Handbooks, first published in 1982, and prepared by joint co-operation between the governments of France, Germany and the UK. The revisions were made by R. C. Petts of Intech Associates in 1994 with financial support from the ODA, under assignment to TRL. The reason for updating the original documents, was due to the fact that they were being used in many countries other than Africa, which is where they were originally intended to be used. The additions to the text include: more information on labour and tractor-based techniques, the development of manpower management and safety at work, the range of maintenance problems assessed was also extended⁴². The manuals are available in English, French, Spanish and Portuguese.

24.2. Proposed audience

The Handbooks are intended to be used by 'men and women at operational level'⁴³. The manual actually states who the proposed users are meant to be, and is written with them in mind. The book is small and one could imagine it being a useful reference in the field, but only once the need for the maintenance had been established. They should be carried in the work bag of a supervisor or foreman, but due to the scope of the manual, the supervisor may also need other books to be able to complete his daily tasks. The manual states that it is a '....ready reference guide'. The handbooks do not cover: inspections, materials sources, specifications and testing, MMS, programming and budgeting or in depth staffing issues. 'The decision on which (maintenance) method to be used should be made by the engineer or senior supervisor based on considerations of resources available, cost policy etc.'⁴⁴, all of which, are areas not covered by the manual. Productivity targets are given (p286), for regravelling. The amount of labour required for the operation is given on (p290).

24.3. Aesthetics of manual

The manual is slightly smaller than A5 size, but could not be described as 'pocket size', due to its weight. The front cover is reasonably colourful and glossy and therefore water repellent to an extent. The pages are also glossy and of good quality paper, so one could imagine the manual withstanding rough handling in the field. The manual has over 300 pages and is split into six parts: A - F, which cover the maintenance activities one would expect to carry out on an unpaved road. The text is reasonably large and written in an unserifed font in bold.

Each part of the manual tends to have text on the right hand page and a photograph or diagram on the left. The only exception seems to be where a sample worksheet etc. appears instead of a diagram. The manual therefore holds interest, as the visuals are of good quality. It could be argued that the number of diagrams used is slightly extravagant, for example: the description of the number of labourers required for a particular task is demonstrated by a sketch of the labourers, and the tools are also shown diagrammatically, which could be a slight over-kill.

⁴² International Road Maintenance Handbook, PIARC, 1994, Foreward, pi-iii.

⁴³ International Road Maintenance Handbook, PIARC, 1994, Foreward, pi-iii.

⁴⁴ International Road Maintenance Handbook, PIARC, 1994, Introduction, px-xvi.

The diagrams themselves are in colour, and are 'cartoon' type diagrams, which depict the information given in the text. Some of the diagrams are perhaps 'light hearted', such as the diagram which depicts a vibrating van driving over a rutted surface. Annotation of the diagrams and photographs is occasionally used, but the way the diagrams are set up, (on the page facing the text), means there is little chance of confusion.

24.4. Structure of manual

The manuals contain a 'Foreword', a 'Contents', and an 'Introduction'. The 'List of Terms' and 'Index' are contained in Volume I. Due to the fact the distribution of the books may be poor, and copies scarce, it could be more appropriate to have at least an index and preferably the list of terms in each Volume. However, it may have been assumed that Volume I would always accompany the other volumes? The diagrams, photographs and other visuals are not numbered and therefore a listing of the visuals is not required.

The length of the chapters seems reasonable and the pages are numbered. The manual contains a page of 'Acknowledgements', a page for notes and sketches, a page for the owner of the book to fill in his/her name etc. and an explanation of PIARC and information on where to order copies of the Handbook. The manual does not contain a reference list or a bibliography.

Blank forms and worksheets are provided throughout the book. The forms could feasibly be copied and used, or alternatively used as a guide for producing more specific forms.

24.5. Scope of manual

The manuals state that the activities are generally split into the following headings: Task, Defects, Resources, Maintenance Method, with reference also being made to labour and machine based methods. Volume II covers the following activities:

- Part A - Grading
- Part B - Labour Based Reshaping
- Part C - Dragging
- Part D - Patching
- Part E - Regravelling (mechanised)
- Part F - Regravelling (Labour and Tractors)

Maintenance is split into 'Routine' and 'Periodic' activities, with an explanation of each being given in the front of the manual. As the commencement of each 'Part' of the manual, the activity is defined as either routine or periodic. Throughout the text, certain important words are written in bold type, to guide the reader to a brief explanation in the 'List of Terms'. Additionally, comments such as 'Do Not', tend to be in bold type for emphasis. Each section includes a worksheet, which could be copied.

The manual details each activity in the following way (for example: patching):

The section is split into 'methods', in this case, Method A is for a 'Mobile Gang' and Method B for 'Labour Based, which refers to a lengthman system.

'Task' includes items such as a brief explanation of when it is used. For example: 'Patching is sometimes required between grading or reshaping operations'⁴⁵. Therefore, it is obvious that the manual is not aiming to tell you when to do the patching, as an engineer will have already decided that fact. It is merely giving an overview of the task. It also gives an overview of what a patch is and who can carry out the activity.

'Defects' lists the types of defects with a diagram, and includes: potholes, ruts, soft spots and erosion gullies. There is no explanation of the cause and no description. It does however

⁴⁵ International Road Maintenance Handbook, PIARC, 1994, Introduction, p155.

mention that patching is not suitable for corrugations or for a large number of potholes in the same vicinity.

'Resources' lists labour (approx. numbers), the types and numbers of tools and plant, material is mentioned (but the engineer would be deciding quality, source etc.), and the types of signs and safety equipment.

'Maintenance methods' provides a sample worksheet, mentions the collection of equipment, fuelling of vehicles, loading of water and gravel, positioning of signs, and finally 'execution of work' details how to patch a pothole.

The section finishes by covering removal of equipment and signs and provides a sample work report sheet.

24.5.1. General observations

The manual appears to use no information that would date, such as costs. The manual is easy to understand, and has tried to avoid misinterpretation by using very simple explanations of the simplest tasks, such as: after finishing patching 'move onto the next job'. The manual could be used as a training aid for new staff, if used with slides or practical demonstrations. Some people regard the manual as being too childish and others say it is effective. There is no doubt that it is a classic, and the diagrams and style of writing appears in other manuals.

25. UNECA ROAD MAINTENANCE HANDBOOK - VOLUME II (MAINTENANCE OF UNPAVED ROADS)

The UNECA series were written in the 1970's by working groups in France, the UK and Germany. There are three handbooks as follows:

Volume I - Maintenance of Roadside Areas and Drainage structures and traffic control devices - Prepared in Germany.

Volume II - Maintenance of unpaved roads - prepared in the UK by TRL.

Volume III - Maintenance of paved roads - prepared in France.

Although consideration was only given to Volume II, it is worth noting that Volume I contains a useful 'List of Terms' for the whole series and also an Index, (which is at the front and called 'Terms'), again, one must assume that a person using Volume II, would also need Volume I.

25.1. General Information

'The Handbooks present, in a simple and understandable form, maintenance practices developed through many years of actual experience with highway problems in Africa'⁴⁶. Published in 1982, the handbooks are available in French and English.

25.2. Proposed audience

The Handbooks are intended to be used by the 'maintenance foreman'⁴⁷. The manual actually states who the proposed users are meant to be, and is written with them in mind. The book is small and one could imagine it being a useful reference in the field, but only once the need for the maintenance had been established. The discussion as detailed for the PIARC IRMH Handbooks applies.

25.3. Aesthetics of manual

As with the IRMH the UNECA handbook is smaller than A5, has a paperback cover in a matt finish. Each manual has a different colour cover, with the writing in black. The cover is not very interesting. The manual has just over 200 pages, and is split into Parts A - D. The text is reasonably large with an unserifed font.

The manual adopts the same format as the PIARC IRMH, in that it has text on the right hand page and diagrams on the left. There appear to be more diagrams (as opposed to photographs). The diagrams are in colour, and as before, annotation is not used. The diagrams are in a similar vein as the PIARC IRMH, with a large number being exactly the same. (The PIARC IRMH was updated from the UNECA). A noticeable difference is that the examples of worksheets and work reports are not presented in a form which could be photocopied, (an issue that was obviously addressed in the update).

A further difference is that the manual uses an edge of page colour coding system for each 'part', Part A = Red, Part B = Yellow. Therefore making it easy to find the right section, a feature which was not retained in the revised version.

25.4. Structure of manual

The manuals contain a 'Foreword', a 'Contents', and an 'Introduction'. The 'List of Terms' and 'Index' are again contained in Volume I, although the Index is called 'Terms' and it appears in the front of the manual, (the scope is not as wide either). The diagrams, photographs and other visuals are not numbered.

⁴⁶ Road Maintenance Handbook, UNECA, 1982, Foreward, pv-vi.

⁴⁷ Road Maintenance Handbook, UNECA, 1982, Introduction, p1.

The length of the chapters seems reasonable and the pages are numbered. The manual does not contain a page of 'Acknowledgements', a page for notes and sketches, or a section to be filled in by the owner. However, the latter two are contained at the back of Volume I, which seems rather surprising. Information on where to order copies of the Handbook, does however appear as the last page. The manual does not contain a reference list or a bibliography.

Blank forms and worksheets are provided throughout the book, yet not in a form which easily allows photocopying, as already stated.

25.5. Scope of manual

The manuals state that the activities are generally split into the following headings: Task, Defects, Resources, Maintenance Method. Volume II covers the following activities:

- Part A - Grading
- Part B - Dragging
- Part C - Patching
- Part D - Regravelling

25.5.1. General observations

No mention is made of 'Routine' and 'Periodic' maintenance, although Volume I does contain a brief explanation. Throughout the text, certain important words are written in bold type and some are marked with an * (although it is not clear where this leads the reader, unless he happens to have Volume I to hand!).

The manual details each activity in virtually the same way as the PIARC IRMH, using the same diagrams. There is only one method given for patching (no split for mobile gang and labour based). There are a few different diagrams, and the descriptions are not as full when compared to the newer version. On the whole it is very similar.

The manual appears to use no information that would date, such as costs. The manual is easy to understand, and has tried to avoid misinterpretation by using very simple explanations of the simplest tasks. The manual could be used as a training aid for new staff, if used with slides or practical demonstrations.

26. OVERSEAS ROAD NOTE 15: GUIDELINES FOR DESIGN AND OPERATION OF ROAD MANAGEMENT SYSTEMS (OVERSEAS CENTRE TRL)

26.1. General Information

The manual is produced by TRL Overseas Centre and dated 1998. It is issued in parallel to the Reference Textbook (Road maintenance management: concepts and systems). The draft of the note was prepared by Dr R. Robinson in association with May Associates, with Mr C. C. Parkman as the Project officer and editor.

26.2. Proposed audience

'This note is intended for engineers and managers in road administrations who are responsible for the specification, procurement, implementation and operation of computer-based road management systems. It offers guidance to help them reach informed decisions about the type of road management system which will best match the needs of their administration and the most effective methods to be used for the operating system'⁴⁸.

26.3. Aesthetics of manual

The manual is A4 in size, and has cardboard cover in colour. The manual has 75 pages, which are numbered within each section. The manual is in black and white, with diagrams, sketches and tables etc., and the mix of visual aids break up the text effectively. The text is reasonably sized and the font is serified. The manual uses small sections of text in black borders, for emphasis.

26.4. Structure of manual

The document is well laid out, with a 'Contents' page with page numbers, a 'List of Figures', an 'Purpose', 'Glossary', 'References', and 'Appendices'. The manual is split into parts A, B & C.

26.5. Scope of manual

Part A is aimed at senior policy and decision-makers, Part B at professional staff recommending the type of system and Part C at staff involved in implementation.⁴⁹

The manual covers the following topics:

Part A - Principals	Part B - System design	Part C - System operation
Road management	System requirements	Training
Approach	System specification	Systems management
	Specification of network information systems	
	Specification of planning systems	
	Specification of programming systems	
	Specification of preparation systems	
	Specification of operations systems	
	Computer requirements	

26.5.1. Part A

The aims of road management are introduced and the categories based on frequency of the operation and the budget are stated in a table: routine, periodic, special and development.

⁴⁸ Overseas Road Note 15: Guidelines for design and operation of road management systems, Overseas Centre TRL, p1.

⁴⁹ Overseas Road Note 15: Guidelines for design and operation of road management systems, Overseas Centre TRL, p1.

The manual states that management is best viewed as planning, programming, preparation and operations functions. The progression through from planning to operation is effectively explained. A table is used to show the management aims, network coverage, time horizon and staff concerned for each function. The *management cycle* is then explained with the aid of a diagram.

The purpose of procedures and what they should specify is covered. The manual states that once the procedures are in place the organisation can consider a computer based system for road management⁵⁰. The two types of computer-based systems are introduced. A table that gives examples of management cycles for the road management functions is provided.

The approach to be adopted with regard to implementing a computer-based system considers: external factors, institutional factors and technical factors (Brooks pyramid), each of which are explained. The approach to the design and operation of the systems is demonstrated using a table which identifies which of the chapters in the manual are relevant to each factor. Some additional information relating to the use of technical assistance from the private sector is provided.

26.5.2. Part B

System requirements – firstly the task of identifying the objectives is covered, with two methods being put forward: policy framework approach and problem tree analysis. (Examples of both are provided). ‘The decision to introduce a computer-based road management system has to be seen as a business decision, not simply a technical option’⁵¹. The manual points out that quantifying benefits of a system are not always easy. The typical cost areas of implementation and benefits of implementation are listed. The priorities for actually implementing the system are also mentioned. For example: the introduction of a network information system may alone yield benefits. Examples of priorities are given.

System specification – ‘....determining the outputs which each system will need to deliver and the categories of data and models that it will use to produce the intended outputs’⁵². The procedure recommended for system specification includes: users, outputs, data and models. Guidance is given on identifying the potential users, and the importance of talking to such people is stressed. The users can help in the confirmation of the required outputs, consideration must also be given to the level of detail. The outputs determine the type of data required for the system and hence the models required to process it. A table gives guidance on information groups suitable for classifying data. Key criteria necessary for selecting data items are given as: Relevance; Appropriateness; Reliability; Affordability, and the meanings are defined in some detail. The level of detail required depends upon the road management function (planning, programming, preparation and operations). Cost estimation is used as an example of how the quality of the data must change with the functions to which it relates. Information quality levels are defined. An explanation of how models can be used in a system is given. Strategies for data collection relating to the desired quality level are defined. An interesting comment regarding network behaviour warns the reader about the calibration factors required for a model to ensure it truly represents the conditions.

Specification of network information systems – ‘Its purpose is to provide a single point of storage for data on every characteristic of the road network’⁵³. They do not use models, they can simply be lists of the roads with certain attributes: the standard outputs available are detailed. Examples of possible outputs from the network information system are also given to aid understanding.

⁵⁰ Overseas Road Note 15: Guidelines for design and operation of road management systems, Overseas Centre TRL, p7.

⁵¹ Overseas Road Note 15: Guidelines for design and operation of road management systems, Overseas Centre TRL, p17.

⁵² Overseas Road Note 15: Guidelines for design and operation of road management systems, Overseas Centre TRL, p23.

⁵³ Overseas Road Note 15: Guidelines for design and operation of road management systems, Overseas Centre TRL, p29.

Specification of planning systems – ‘...a planning system might be used to help determine appropriate treatment standards for the various road hierarchies within the network, so as to minimise the life cycle costs of road construction and maintenance and reduce road user costs; or to help examine the likely effects of different budget levels on future road conditions’⁵⁴. The likely outputs of a planning system are listed. Examples of output of projected road condition for a given budget and an example of output of budget required to maintain condition are used to demonstrate the type of forecasts commonly produced by planning systems. An explanation of the types of models is given: traffic growth; road deterioration; treatment selection; prioritisation. The rules and basis for the analysis is briefly introduced.

Specification of programming systems – ‘In their most common application, they help decide which road sections are likely to warrant treatment in the next budget period, and they assist in prioritising treatment.....’⁵⁵. The likely outputs of the system are listed and a specimen output demonstrates the point. The models used are not discussed as the discussion under planning systems apply.

Specification of preparation systems – ‘Preparation systems perform a variety of road management tasks at the stage when works are being packaged for implementation’⁵⁶. The outputs are indicated and an example given, and the typical models are specified.

Specification of operations systems – ‘Operations systems assist with the management of on-going activities, supporting decisions that are typically made on a daily or weekly basis’⁵⁷. The outputs are listed, and examples are given.

Computer requirements – a discussion around hardware and software requirements ensues. The manual gives useful advice of important issues, and advantages and disadvantages of various alternatives. Some important reminders are also given: ‘An administration introducing computer-based systems for first time will have most to gain by adopting a simple approach that is in scale with its institutional capability’⁵⁸.

26.5.3. Part C

System operation – training is discussed and the reader is directed to a book which deals with training in more depth. Training needs analysis is explained and the different training levels are also introduced and demonstrated with a table. The different training topics are covered with a course outline for each of the four areas, which includes an identification of the target audience, the purpose of the training and the type of training. Monitoring of the training is also mentioned.

Systems management – the activities involved are listed as: defining responsibilities, controlling systems and data and monitoring and feedback. Each of the activities are then discussed in detail.

26.5.4. Appendix

A useful glossary of terms is provided. An institutional appraisal check-list (similar to one produced in 1989). Also, example applications of the information quality level concept.

⁵⁴ Overseas Road Note 15: Guidelines for design and operation of road management systems, Overseas Centre TRL, p33.

⁵⁵ Overseas Road Note 15: Guidelines for design and operation of road management systems, Overseas Centre TRL, p38.

⁵⁶ Overseas Road Note 15: Guidelines for design and operation of road management systems, Overseas Centre TRL, p41.

⁵⁷ Overseas Road Note 15: Guidelines for design and operation of road management systems, Overseas Centre TRL, p46.

⁵⁸ Overseas Road Note 15: Guidelines for design and operation of road management systems, Overseas Centre TRL, p51.

26.5.5. General observations

The manual is in stark contrast to the others considered, as it is putting across concepts which are often far from being simplistic. The manual is methodical in the way in which it develops the ideas. Sufficient diagrams are used, (it would be difficult to see what difference more diagrams would actually make). The manual cleverly pitches the message at different levels of personnel. Reading the manual in conjunction with the book on 'Road maintenance management: concepts and systems', would probably help the reader grasp the ideas. Explanations are frequently backed up with examples to help understanding. It is not a maintenance manual, it is a set of guidelines which deals with a very specific topic. The style is a cross between the usual Overseas Road Note and a World Bank document.

It is a "this is what we advise you to consider" manual.

27. MANUALS FROM FIJI

27.1. General Information

The manuals put forward for consideration by the Senior Maintenance Engineer of the Road Maintenance Support Unit are as follows:

Name of manual	Produced by	Dated
Road Works Safety	Road Maintenance Support Unit	1994
Contract Documents and Administration Manual (PWD Road Maintenance Staff Training manual).	FRUP II Road Maintenance Strengthening Unit	1998
Bridge Maintenance Works (PWD Road Maintenance Staff Training manual)	FRUP II Road Maintenance Strengthening Unit	1994
Basic Concepts for Road Design and Construction (PWD Road Maintenance Staff Training manual)	FRUP II Road Maintenance Strengthening Unit	1994
Working on the road	Road Maintenance Support Unit	1994
Road Maintenance Training Manual	Road Maintenance Support Unit	1994
Road works design construction and administration (PWD Fiji Road Maintenance Training Manual)	FRUP II Road Maintenance Strengthening Unit	1997
Bituminous Surfacing Manual	Road Maintenance Support Unit	1994
Periodic Works for Sealed and Unsealed Pavements (PWD Road Maintenance Training)	Road Maintenance Support Unit	1996

Table 3 - Manuals from Fiji

The Road Maintenance Support Unit was set up as part of the Fiji Road Upgrading Project (FRUP II).

27.2. Proposed audience

The audience for the manuals generally appears to be Division Engineer and his staff. (Sometimes the proposed audience is stated and sometimes not).

27.3. Aesthetics of manual

The manuals are A4 in size. They are photocopies, but it is likely the originals were in black and white. A variety of sizes and styles of text are used. Diagrams, photographs, tables and charts are used along with hand drawn sketches. The manuals are easy to read.

27.4. Structure of manual

The structure will be briefly discussed in relation to each individual manual, (as they are all slightly different).

27.5. Scope of the manuals

The manuals are all separate and when the Senior Maintenance Engineer was asked for all manuals relevant to maintenance used in Fiji, the following list is basically what he supplied.

- Road Works Safety
- Contract Documents and Administration Manual
- Bridge Maintenance Works
- Basic Concepts for Road Design and Construction
- Working on the road

Road Maintenance Training Manual
Road works design construction and administration
Bituminous Surfacing Manual
Periodic Works for Sealed and Unsealed Pavements

27.5.1. Road Works Safety

Advises on safety with regard to different activities and in relation to different types of staff and their equipment. The contents of the manual are as follows:

Traffic control at work sites
Operator and driver training
Truck drivers
Mobile plant operators
Truck and plant maintenance
Minor plant and equipment
Survey parties
Excavation of existing roadways
Pipe laying
Haul road construction
Road sealing
Protective clothing and equipment
Housekeeping and other safety measures
Safe use of explosives
First Aid

The importance of signing and traffic control is dealt with together with appropriate speed limits at road works. The advice given is what 'should' be done, standard signs are not detailed. Machine safety checks are briefly mentioned along with specific advice for truck drivers. Advice to mobile plant operators includes a long list of 'do's' and 'don'ts', relating to specific pieces of equipment, such as bulldozers, excavators etc. Warnings relating to specific pieces of minor equipment are given. With regard to the excavation of existing roadways, very brief advice on locating underground services and also accommodating pedestrian traffic is given. Pipe laying – rules for excavating trenches, storing pipes, and placing, (the advice is again brief). The sections on haul roads and road sealing look at potential causes of accidents. The protective clothing and equipment is listed in relation to when it should be worn. A number of injuries and first aid measures are given. Strengths of lifting gear and the types of protective clothing to be worn by different members of staff are given for day/ night/ inclement weather.

The manual gives advice on what should be considered and thought about, but does not offer detailed information. Sketches are used to illustrate points in an often light hearted fashion.

27.5.2. Contract Documents and Administration Manual

Outlines the broad concepts behind contract types, documentation and administrative procedures relating to routine and periodic road maintenance. The content is as follows:

Contracts initiation criteria
Definitions and types
Bidding procedures
Documents
Supervision and administration
Completion
References

The definition of a contract is given and the difference between fixed price and cost plus contracts is explained. The bidding procedures are then covered – this includes prequalification, advertisements, instructions to tenderers and assessment of tenders. Contract documents – a list of the contents of a PWD contract, instructions to tenderers (blank forms provided). The requirements for the general conditions of contract are listed. Special conditions, technical specification, drawings etc are also briefly mentioned together with the tender offer and acceptance, and the contract agreement. Each point is defined and explained. The Engineers key responsibilities are listed. Variations, instructions, progress payments and quality control are explained, together with quality assurance, site meetings, progress reports, liquidated damages, completion certificate and payment. The purpose of all are explained. The key events in contract are summarised. The contents of a completion report are mentioned. References are provided. A number of blank forms are provided in the appendices, along with example minutes from a site meeting. As stated at the start of the document, the intention was to outline key principles only, not to cover the topics exhaustively. Each procedure and step is explained and the reasons specified. The level of detail obviously assumes that the reader is already involved in contracting, or is perhaps a new member of staff receiving training. This manual does not really use diagrams or sketches, which is not surprising as the subject matter does not lend itself to visuals.

27.5.3. Bridge Maintenance Works

Emphasises the importance of bridge maintenance and that it should be considered as routine, periodic or rehabilitation works. The contents of the manual is as follows:

- General considerations
- Bridge types
- Bridge elements
- Bridge maintenance regimes
- Bridge inspections
- Bridge maintenance activities
- Rehabilitation maintenance
- References

A checklist for notifying people restricted access of closures of bridges is given. The 3 categories of bridge are listed. The elements of the bridge are then listed, with their function and material types. The bridge maintenance regime lists the type of work and frequency under the headings of routine etc. The bridge inspection requirements deal with frequency, personnel to undertake the work and the type of report to be produced. The activities are then listed in more detail, with the gang, equipment, materials and work description being listed for each task. The categories of periodic maintenance are dealt with by considering the likely defect for each construction type. Rehabilitation maintenance is not covered at all, as the works are described as major. Blank forms appear at the back of the manual, along with sketches of the bridge types, and some extracts from reports on dealing with bridges. The manual would probably have benefited from more diagrams and sketches, especially where it describes routine maintenance procedures for bridges. As a result, it does not always go into sufficient detail.

27.5.4. Basic Concepts for Road Design and Construction

The basic concepts are outlined in a broad manner – key principles are outlined. The contents are as follows:

- The history of roads
- Definition of roads
- Types of road
- Make up of a road
- Design concepts
- Climate and environmental factors

Summary of Pavement Design Steps Constructions

The history of roads gives an overview from ancient times, through to present day. The definition of road is given as: 'A roadway is a formed construction to continually provide: a structurally sound, durable, and safe thoroughfare for the passage of motor vehicles'⁵⁹. The types of road are split into rigid and flexible and then further split to sealed and unsealed. A description of each layer of the road and its purpose is given. The concept of design life is introduced along with loading and the stresses it induces. Material properties are mentioned with regard to the tests which should be carried out. Little explanation is given. Limited guidance is given on options to be considered for carrying out construction/ upgrading works. The climate and environmental factors are very briefly mentioned - it is pointed out that the weather and environment affects the performance of the road, a list of aspects requiring consideration, such as: rainfall and seasonal distribution etc, are given. The summary of pavement design steps are minimal: 'In essence the steps are: set design life and determine ESA's, measure subgrade soaked CBR, select most suitable and base course types and design pavement thickness using standard charts'⁶⁰. No further information is provided. The construction of a road is dealt with in stages. 'Pertinent points' only are provided. The information provided is minimal. Min/ max compacted depths of graded granular aggregate metals to be used in pavement construction are listed. Brief information on intercept culverts is given (spacing).

This manual does not really make use of visual aids to accompany the text. Instead, the drawings and sketches are provided at the back of the book, grouped together under specific headings to accompany the text. It may have been more effective to include the diagrams with the text, for easy reference. There are many visuals, some are quite detailed and it would have probably improved the manual, to place the diagrams with the text.

27.5.5. Working on the road

The purpose is stated as: 'To set out and establish safe work sites for which road maintenance operations can be carried out with minimal disturbance to travelling public that are consistent with already established guidelines and policies and that is in accordance with the Interim Manual of Signing/ Pavement Marking'⁶¹. A diagram demonstrates the principals of traffic control – advance warning, direction and protection and end of works. Each is then dealt with individually. Actual sign diagrams are not provided, but advice on where to place regulatory and warning signs is given, along with advice on when they should be used. Safety equipment is listed. Advice to traffic controllers is slightly more detailed and includes when the controllers are likely to be required, and what they should do. The section on setting up deals with the factors that require consideration prior to the start of the works. Work site rules deals with the 'dos' and 'don'ts' for road signs and equipment, safety etc. Most of the advice is brief, but more information is provided for footpath working and night working. Finally a useful checklist of the stages which need consideration is given. A table of spacing for signs, and cones, together with some blank worksheets, complete the manual. The manual does not go into great detail, but it seems to cover most of the pertinent issues and uses visuals where necessary.

27.5.6. Road Maintenance Training Manual

The purpose is stated as: 'To establish and maintain an effective and proven system of road maintenance techniques that are consistent with already established guidelines and procedures and to provide the client (The Government of Fiji through his representative the Public Works Department with what he wants'⁶². The introduction states that the manual has been partly based on training manuals available in New Zealand, but have been tailored for use in Fiji. The manual is targeted at supervisor level. The manual is laid out in a similar way to the activity sheets seen in other manuals. The 'P' section seems to relate just to sealed pavements. Each activity is dealt with separately and split into the following sections:

⁵⁹ Basic concepts for road design and construction, PWD FRUP II RMSU, 1994, p6.

⁶⁰ Basic concepts for road design and construction, PWD FRUP II RMSU, 1994, p17.

⁶¹ Working on the Road, RMSU, May 1994, Purpose Statement.

⁶² Road Maintenance Training Manual, RMSU, January 1994, Purpose Statement.

- Purpose
- Materials and equipment
- Causes
- Consequences of neglecting repair
- Method of repair

Some photographs are used to demonstrate the defects, some advantages of specific remedies are given. More visuals could be used to demonstrate the method of repair. The productivity is not specified. The 'D' section deals with drainage. The 'R' section deals with unsealed roads, (only grading, and resheeting are covered). The 'S' section deals with verges, signs etc. Lastly, a quite comprehensive glossary is provided at the back of the manual. In many cases the manual would have benefited from the addition of diagrams to demonstrate the repair methods. However, as the manual is aimed at supervisors to allow them to train their staff, one would imagine that the supervisor would know the procedures and would demonstrate them to his staff. The manual states that the procedures are often well known, but are often not carried out correctly.

27.5.7. Road works design construction and administration

The manual is intended for Supervisors, their assistants, Division Engineers and Technical officers, and provides the concepts behind road design and construction with regard to periodic works. *'The topics are not exhaustively dealt with, the intention is to outline key principles only'*⁶³. The contents are as follows:

Roadway geometric design principals

- Materials
- Earthworks
- Plant
- Drainage
- Programming and estimating
- Effective talking and communicating
- Report writing
- The principals of management

The geometric design section specifies certain criteria applicable to the roads in Fiji, it seems to be a quite comprehensive section, although not strictly of interest to the current work. The section on materials firstly lists commonly used materials, and then gives further description. A table provides details on the materials, such as their value as subgrade etc, drainage properties. It is a useful table which may be of use in Element C. Material properties are briefly covered, and a table of key weight, compaction and handling properties is given. The section covering earthworks, briefly introduces clearing, cutting and filling, gives some advice on the maximum steepness for cuttings. A few diagrams are provided to demonstrate failures in cuttings. Slips and landslides are discussed in slightly more detail. The section on plant considers equipment and plant commonly used and their advantages and disadvantages, diagrams are used. The section is quite comprehensive. The section on drainage deals with the types of road waterways and their suitability. Culvert pipe sizing design is dealt with in steps and relevant tables of culvert pipe flows and velocities are listed. Worked examples are usefully provided. Debris control structures are depicted. Programming and estimating stresses the importance of accurate estimates. The phases in roading construction jobs are introduced and the general method of approach for programming and estimating is listed. An overview of cost estimating is provided. Examples of a programming charts are also provided. The section on effective communication is rather unexpected, it is meant for the benefit of any member of staff who has to delegate. The section is brief and one is left wondering if the section should have been included at all, as it does not necessarily explain the principles in sufficient detail and almost assumes a prior knowledge. For example: the

⁶³ Road Works Design, Construction and Administration, FRUP II RMSU, April 1997, Preface.

section on body language states that talking can be aided by appropriate body language, but it does not explain how. Report writing is dealt with in slightly more detail, with the structure of a good report being demonstrated and explained. Examples of written faxes, memorandums, letters and reports are then provided. The principals of management are covered next. An overview of the principals of management are given along with the essential steps in the management cycle. The manual concludes with a reasonably large section on the design and construction of Irish crossings, which for some reason is not included in the drainage section.

27.5.8. Bituminous Surfacing Manual

The manual is aimed at Engineers, Supervisors and Foremen and the purpose as specified is: 'To set out and establish procedures and practices for bituminous surfacing both sprayed and plant mix work that are consistent with already established guideline policy'⁶⁴. As the manual deals with bituminous surfacing it will not be considered further as part of this work.

27.5.9. Periodic Works for Sealed and Unsealed Pavements

This manual deals with rehabilitation and reconstruction. The manual points out that in an ideal world, effective maintenance would ensure that rehabilitation and reconstruction would not be required. It goes on to acknowledge the fact that financial restraints mean that such a scenario is rare. The manual is split into planning, rehabilitation and reconstruction. The steps to planning are listed as: finalise design requirements, estimate the costs of the works, ensure adequate funding is available, identify material sources, manpower and plant etc and then prepare a construction programme. Rehabilitation and reconstruction are then dealt with separately as sealed and unsealed pavements. Various issues are listed which need to be considered during the site inspection. Diagrams are not provided within the text, but are included at the back of the manual. The rehabilitation process is listed, but not necessarily in sufficient detail. The difference between rehabilitation and reconstruction is specified. The procedure for reconstructing unsealed and sealed pavements is then listed. Quality control testing is also mentioned, but not in great detail and explanations of how to undertake the tests are not provided. The large diagrams which appear at the back of the manual, could possibly have been more effectively used within the text to which they refer. The sketch diagrams are however quite effective. The manual sets out the steps required, but further advice would perhaps be needed from a supervisor or engineer to ensure the works were undertaken effectively.

27.5.10. General observations

There are 9 manuals in all, which have been produced over a period of about 4 years, obviously as part of an assistance programme, probably funded by a donor. Had the manuals been produced at the same time, one would be left wondering why certain subjects had been placed together. If one were to dismantle all the sections from all the manuals, it would be possible to make each manual cover rather more specific areas, such as just drainage, or just unsealed roads etc. However, the reason the subject matter does not always gel too well, is because they were written at different times. The manuals contain a large quantity of information, and diagrams are generally used. The style of each manual is not entirely the same, as they have been written by different people and it does not appear that a 'house style' has been adopted. Most of the manuals state that they are intended to give an overview and are not exhaustive etc. If they are intended as a training aid then the lack of information in certain areas could be forgiven. However, if the purpose of a manual is to act as a ready reference guide for different levels of staff, then they may fall short in some instances.

⁶⁴ Bituminous Surfacing Manual, Road Maintenance Support Unit, April 1994, Purpose Statement.