Maintenance for unpaved roads carrying very low levels of traffic

Developing a spot improvement manual for basic accessibility

by
Simon Done and John Rolt

Presented by Brian Ferne

AIPCR/PIARC Seminar
Bamako, Mali
February 2006

Background

- The International group at TRL has been carrying out research for the benefit of developing regions of the world for many years
- Some of the key outputs of this research are guidelines and best practice guides
- These include the following…

Overseas Road Notes

Overseas Road Notes

And ORN 20
'Management of rural networks'
Aimed at the very low traffic end of the spectrum

Scope of the Road Notes

Cumulative Traffic (mesa)

0 | 0.25 | 0.5 | 0.75 | 1.0 | 1.25

ORN - 1 Maintenance management for District engineers

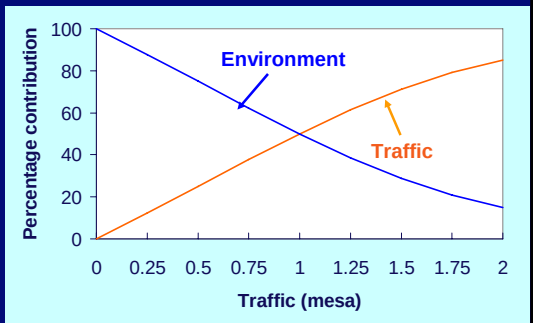
ORN 2 – Maintenance techniques for District engineers

ORN 18 – A guide to pavement evaluation and maintenance of bitumen surfaced roads

ORN 20 – Management of rural networks

New — New project aimed at very low traffic where environmental effects dominate road behaviour

Contribution of environment and traffic to road behaviour (schematic)



Scope of the new project

- The majority of roads in most developing countries fall into the category of 'low traffic'
- Although the level of motorised traffic is low, the roads perform a vital function for the rural population
- Maintaining them has always been a problem
- Insufficient funds is one reason but..
- Traditionally priority has been determined by traffic
- Social benefits need to be included (ORN 22)
- Methods of maintenance suitable for higher traffic levels are not suitable because of cost

National roads…

… and Regional roads

But there is not enough money available to construct and maintain all regional roads to the same high standard

As a result, there are many problems on regional roads

Rural accessibility

Erosion

Potholes

Missing structures

Because of these problems, vehicles often do not travel

People suffer because they have to walk to fetch water, go to the market, visit the hospital or work on their farms.

How can we improve regional roads at low cost so that vehicles can travel and so that funds remain to improve other roads to rural communities?

Improve critical sites

Leave passable sections

Basic Access

This level of service is called Basic Access

It does not permit high speed travel

But it provides reliable and safe access

Basic access

What does Basic Access involve?

What are typical critical sites?

What are the likely solutions?

Problem: absence of water crossing

Solution: culvert…

…drift…

…submersible bridge…

…low cost splash

Problem: erosion in side drain

Solution: mitre drains…

…and drain lining

Side accesses…

…can cause side drains to overtop and erode the surface

Solution: access structures

Problem: flooding

Solution: embankment

Problem: erosion on an unformed track

Solution: diversion banks

Problem: surfaces can be dusty…

…slippery…

…badly eroded…

…with potholes…

Solution: gravel…

…seals…

…spot sealing…

…geo cells

And if the road or track is passable…

…do nothing…

…do nothing

Spot improvement manual

Reasons for adopting spot improvements:

Very large rural network
Low available funding
Low maintenance capacity
Low levels of traffic
Priorities of local road users
Deterioration of rehabilitated road

Spot improvement manual

Decision made to commission a spot improvement manual

Spot improvement manual: problems 1

Must be Acceptable to:

- Road authority staff
- Local residents
- Local politicians
- Contractors

Spot improvement manual: problems 2

Change of approach/policy:

- Definitions of access
- Definitions of spot improvements
- Contract forms
- Publicity/dissemination

Spot improvement manual: problems 3

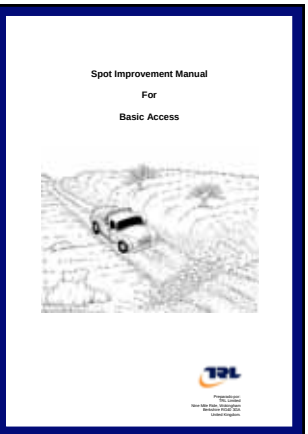
Engineers require:

- Focus on access
- Flexibility
- Understanding of deterioration
- Confidence
- Guidance/training
- Authority to carry out spot improvements

Spot improvement manual: solutions

- Include in national road policy
- Allow inclusion in maintenance contracts
- Commission a Manual
- Include training
- Series of dissemination workshops
- National launch of Manual

A manual has been written to help with the design of spot improvements and the provision of Basic Access



Chapter 1 – Introduction

- Description of Basic Access
- Description of spot improvements
- Target group of the Manual
- Involvement of local communities
- Additional useful manuals

Definition of Basic Access:

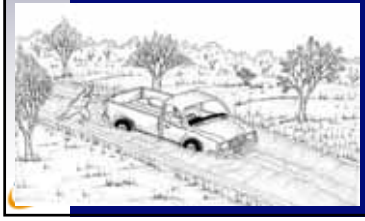
For a standard vehicle:

* Pass all year
* Travel above a speed of 20 km/h
* No one in danger
* No damage to the road
* No damage to the vehicle
* Road condition unlikely to worsen

Chapter 2 – Identify critical sites

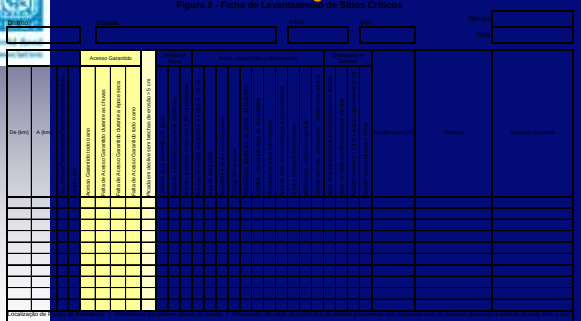
- List of different types of defect
- Water courses
- Soils, surfaces and alignment
- Drains and slopes

Some defects



Form – for recording critical sites

Figura 2 - Ficha de Levantamento de Sitios Críticos



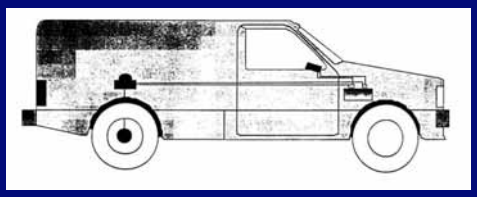
Guidance on carrying out a survey

Other survey techniques

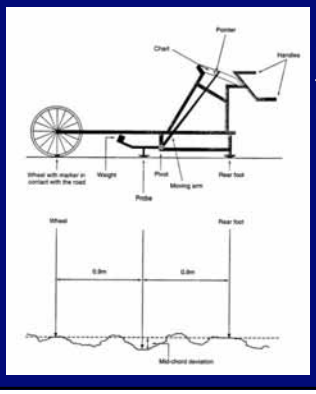
Measuring Surface Deflection

For Unpaved Primary Routes

Equipment for measuring vehicle response - bump integrator mounted on vehicle rear axle



For Unpaved Primary Routes



Equipment for measuring longitudinal profile - MERLIN

For Unpaved Feeder Roads

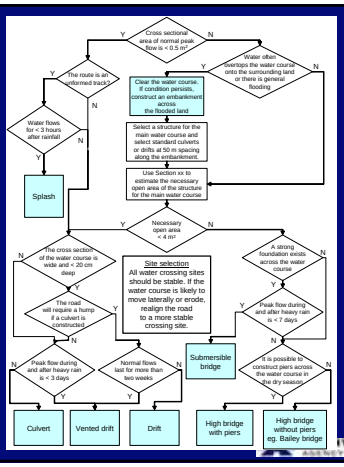
Instead use video records

- more consistent
- can provide reference

Chapter 3 – Select appropriate solutions

- Water courses – water crossing structures
- Erosion on a track – diversion banks
- Loose sand – formation and improved surface
- Swamp – embankment
- Erosion in side drain – mitre drains and scour checks

Structures selection chart



Chapter 4 – Estimate the costs

- Bill of quantities

Chapter 5 – Reduce costs

1. Construct more cheaply - Can the communities contribute materials?
2. Prioritise the roads - Which road is the more important?
3. Prioritise the critical site - Can we adjust the definitions of Basic Access?
4. Reduce the length - Can we improve only the first part of the road?

Chapter 6 – Implement spot improvements

- Self-help (by local communities and organisations)
- Commercial (by contractors)

Advice on how to arrange for the work to be carried out – large teams

Advice on how to arrange for the work to be carried out – individual workers

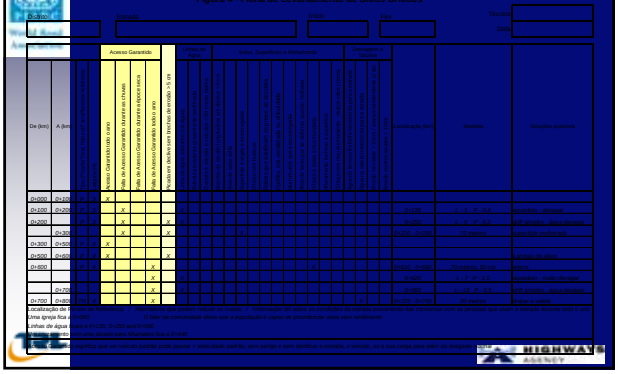
Advice on how to arrange for the work to be carried out – small plant

Or even small work carried out by a community

Chapter 7 – Training

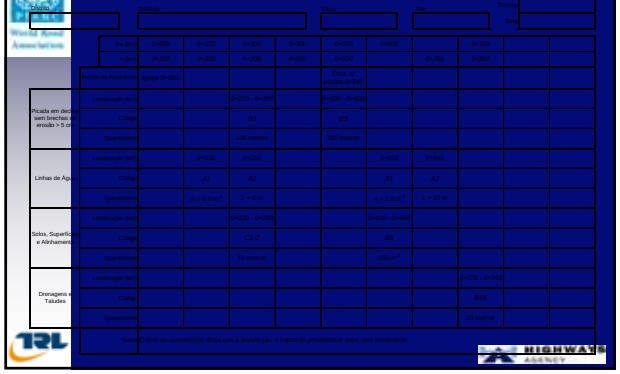
Completed form

Figura 4 - Ficha de Levantamento de Sítios Críticos



Completed plan

Figura 5 - Mapa de Localização de Melhoramentos Localizados



Chapter 8

Catalogue of solutions

Alternatives
Descriptions
Sketches
Drawings
Quantities

Solução	Código	Norma
Secção A – Estruturas de Linhas de Água		
Estimativa do tamanho da estrutura	A0	
Aqueduto	A1	
Drift simples	A2	
Drift de pedra arrumada	A3	
Drift de tubos	A4	
Passagem de aterro	A5	
Ponte submersível	A6	
Ponte alta	A7	
Secção B – Picadas, Estradas e Drenos		
Prevenção da erosão	B1	
Reparação da erosão	B2	
Lombas de alívio	B3	
Remoção de murumuchê	B4	
Remoção de raízes	B5	
Picada estabilizada	B6	
Enchimento	B7	
Aterro	B8	
Abaulamento	B9	
Estrada sobre rocha	B10	
Sarjas	B11	
Cascatas	B12	
Melhoramento da valeta	B13	
Valas de crista	B14	
Vala	B15	
Limpar a valeta	B16	
Melhorar o acesso lateral	B17	
Bio-engenharia	B18	
Corte de capim	B19	
Limpeza	B20	
Destroncamento	B21	
Realinhamento	B22	
Secção C – Superfícies Melhoradas		
Picada estabilizada	C1	
Picada com saibro	C2	
Saibro na estrada	C3	
Saibo de betume	C4	
Sand seal	C4-1	
Slurry seal	C4-2	
Otta seal	C4-3	
Chip seal	C4-4	
Gen Cado	C5	
Base de Emulsão Betuminosa (ETB)	C6	
Estabilização mecânica de saibo	C7	

Estimating the size of a structure…

Rational method

Terreno	C1
Muito plano	0.10
Ondulado	0.14
Montanhoso	0.20

Solo	C2
Arenoso	0.15
Médio	0.21
> 50% rocha ou pavimentado	0.39

Vegetação	C3
Densa	0.25
Médio	0.35
Nenhuma/ligeira	0.50

C = C1 + C2 + C3

Tabela 17 Calculando C para a captação de chuva

C	Área de captação (ha) [1]	Área aberta necessária (m²) [2]
0.50	< 5	0.5
	5-10	0.5
	10-20	0.8
	20-50	1.6
	50-100	2.5
	100-250	4.7
	250-500	7.1
0.50 - 0.75	< 5	0.5
	5-10	0.5
	10-20	1.2
	20-50	2.5
	50-100	3.6
	100-250	6.5
	250-500	10.5
0.75 - 1.00	< 5	0.5
	5-10	1.5
	10-20	1.7
	20-50	3.6
	50-100	5.0
	100-250	9.5
	250-500	14.9

Tabela 18 Área aberta necessária para uma estrutura (2)

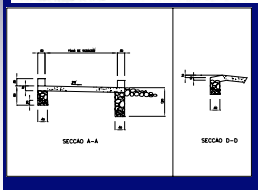
To prevent overtopping of a structure

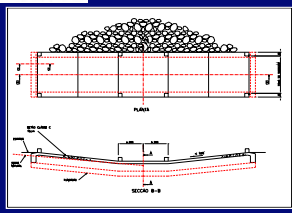
Culvert

Culvert – direct inputs

Recurso	Unidade	Quantidade
Cimento	50 kg	21
Areia	m^3	3
Pedras de betão	m^3	4
Alvenaria	m^3	4
Ferro	kg	42
Trabalhadores	Pess-dia	20
Capataz	Pess-dia	2
Pedreiros	Pess-dia	3
Tractor	Equip-dia	2
Atrelado	Equip-dia	2
Tanque de água	Equip-dia	10
Betoneira	Equip-dia	10

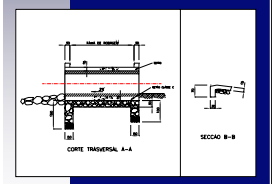
Drift

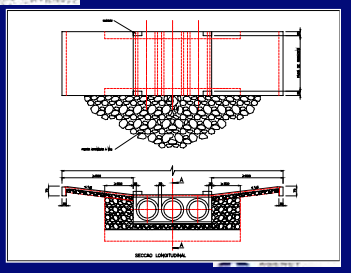




Splash

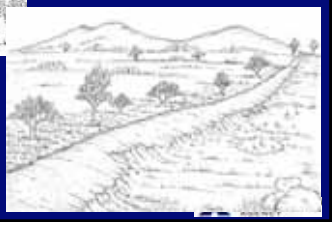
Vented drift



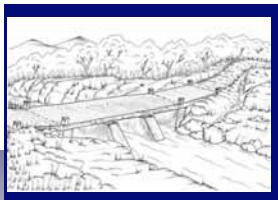


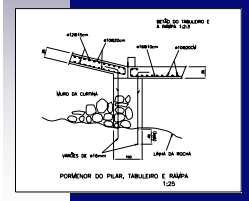
Embankment

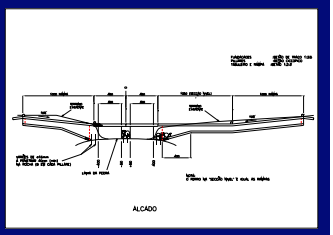
Construction
and
Repair



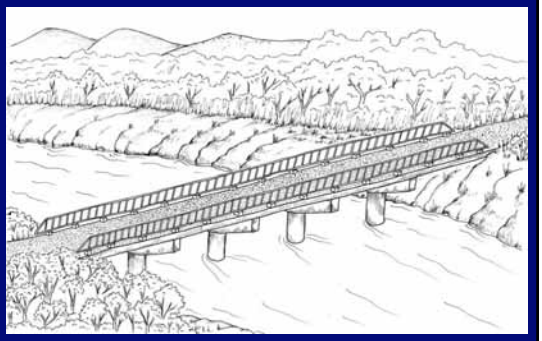
Submersible bridge







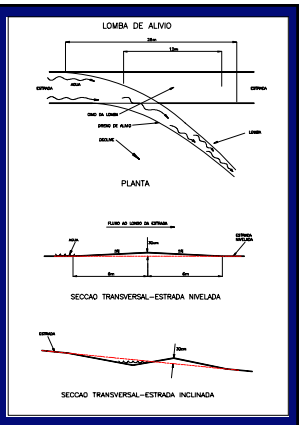
High bridge



Prevention of erosion

Resolve problems while still small
Identify and treat the source of erosion
Divert water to surrounding land
Place top soil and plant grass
Construct improved surfaces
Clean the drains
Shape the road surface well
Maintain all roads and tracks

Diversion banks to prevent erosion on a track



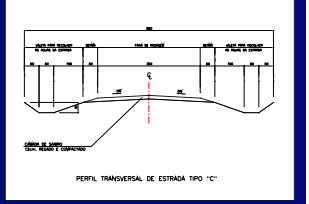
Removal of anthill

Removal of roots

Separate track

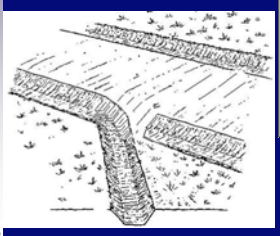
Sustainability in the UK!

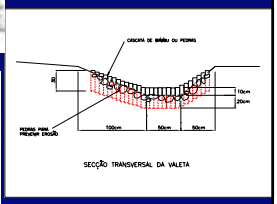
Road formation



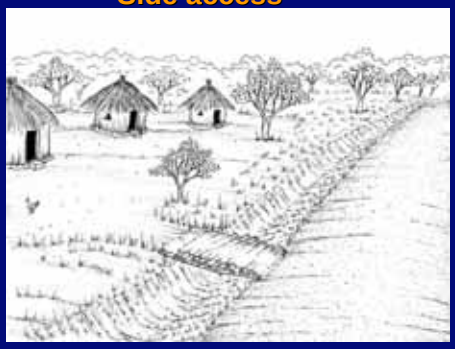
Road on rock

Drains, mitre drains and scour checks



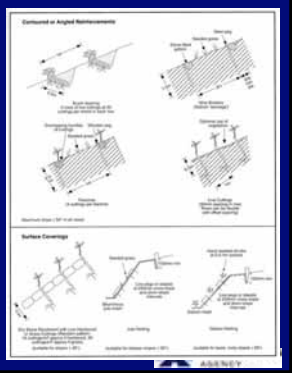


Side access



Bio-engineering

Vegetation on slopes
Stone paving
Live scour checks
Vegetation fascines



Grass cutting, bush clearing & tree removal

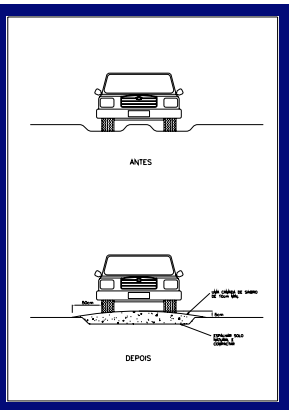
Improved surfaces

Slippery
Erosion
Loose sand
Dusty
Weak
Swampy
Rock outcrops

Selection table for improved surfaces

Tráfego (veículos por dia)	Condições	Base *	Superfície
Mais de 100	Bons materiais naturais disponíveis	Saibro	Otta seal duplo Chip seal duplo
Mais de 100	Bons materiais naturais não disponíveis	Solo quimicamente estabilizado	Otta seal duplo Chip seal duplo
50-100	Bons materiais naturais disponíveis	Saibro	Otta seal simples Chip seal simples Grit seal
30-100	Bons materiais naturais não disponíveis	Base de Emulsão Betuminosa (ETB) *Geo Cells*	Otta seal simples Chip seal simples Grit seal
Menos de 50	Bons materiais naturais disponíveis	Saibro	
Menos de 50	Bons materiais naturais disponíveis Declive ingreme	Saibro	Otta seal simples Grit seal Sand seal duplo
Menos de 30	Bons materiais naturais não disponíveis	Base de Emulsão Betuminosa (ETB) *Geo Cells*	Otta seal simples Grit seal Sand seal duplo

Track with gravel



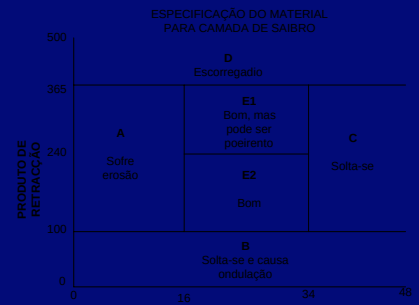
Gravelling

Gravel tests

Grading coefficient
Shrinkage product

Settlement test
Drying test

Gravel selection chart



Bituminous seals

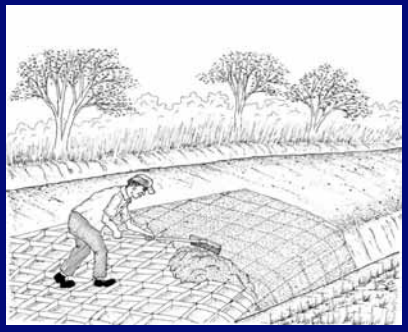
Sand seal – area

Grit seal – 0-6 mm

Otta seal – 0-16 mm

Chip seal – 10 ou 13 mm

Geo cells



Summary of Manual

Define Basic Access
Identify critical sites
Select solutions
Estimate costs
Reduce costs
Design the improvements
Construct the improvements
Train

We can provide access to the rural communities, so they can reach the farms….

…trade their crops…

….visit hospitals…

….and go to markets

The End


Merci
Pour votre attention!
Thank you for listening
bferne@trl.co.uk