

Maintenance for unpaved roads carrying very low levels of traffic

Developing a spot improvement manual for basic accessibility
by
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Presented by Brian Ferne

AIPCR/PIARC Seminar
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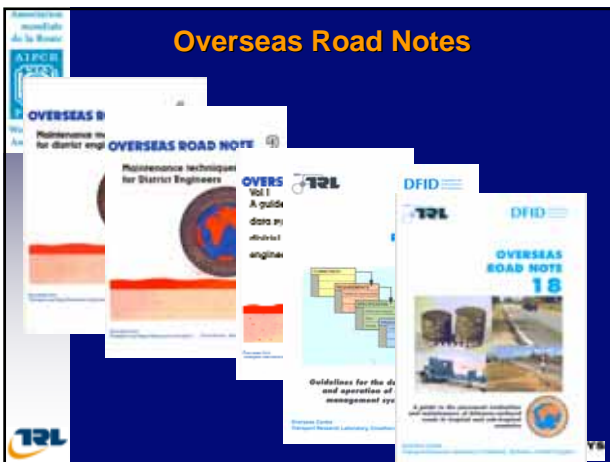


Background

- 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...

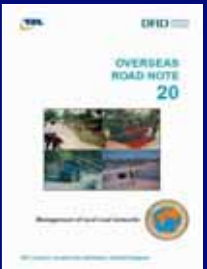
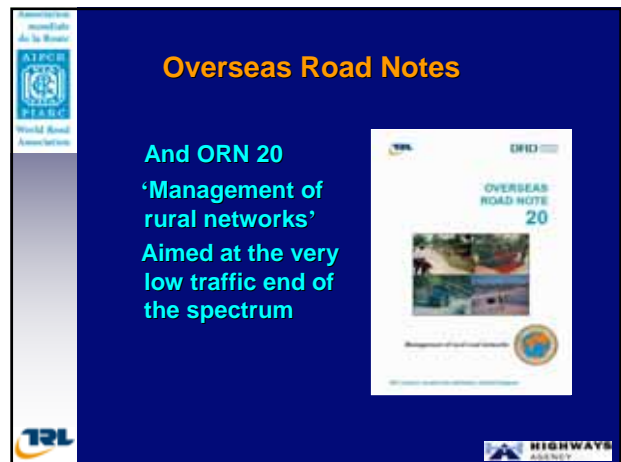


Overseas Road Notes



Overseas Road Notes

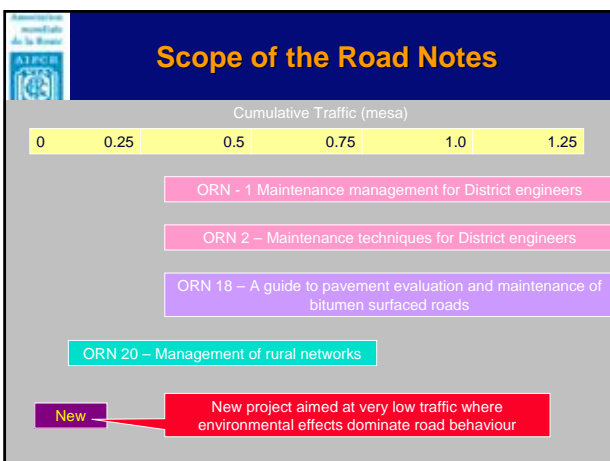
And ORN 20
'Management of rural networks'
Aimed at the very low traffic end of the spectrum

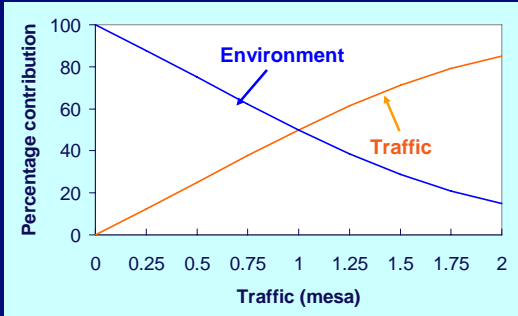
Scope of the Road Notes

Cumulative Traffic (mesa)
0
0.25
0.5
0.75
1.0
1.25

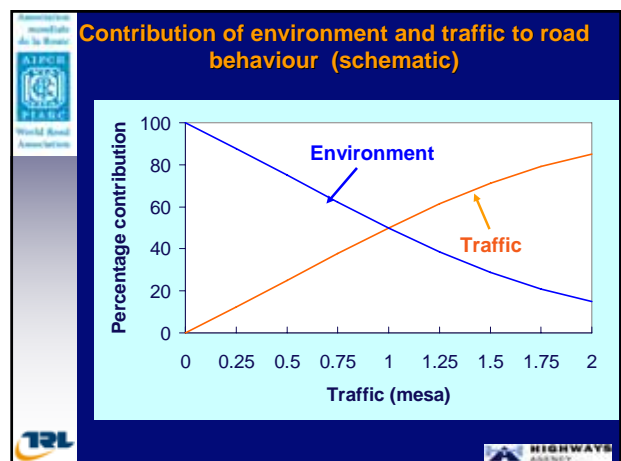
- ORN - 1 Maintenance management for District engineers
- ORN 2 – Maintenance techniques for District engineers
- ORN 18 – A guide to pavement evaluation and maintenance of bitumen surfaced roads
- ORN 20 – Management of rural networks
- New** – New project aimed at very low traffic where environmental effects dominate road behaviour



Contribution of environment and traffic to road behaviour (schematic)




Traffic (mesa)	Environment Contribution (%)	Traffic Contribution (%)
0	100	0
0.25	90	10
0.5	75	25
0.75	55	45
1.0	40	60
1.25	25	75
1.5	15	85
1.75	10	90
2.0	15	85







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



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Potholes



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Missing structures



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Because of these problems, vehicles often do not travel



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



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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?

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Improve critical sites



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Leave passable sections



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Basic Access

This level of service is called Basic Access
 It does not permit high speed travel

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But it provides reliable and safe access



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Basic access

What does Basic Access involve?
 What are typical critical sites?
 What are the likely solutions?

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Problem: absence of water crossing



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Solution: culvert...



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...drift...

A photograph showing a dirt road crossing a shallow stream. A makeshift structure made of stones and concrete blocks is built across the stream to support the road. Several people are standing near the structure, and a bicycle is parked on the left side of the road.

...submersible bridge...

A photograph showing a dirt road crossing a stream. A simple wooden bridge is built across the stream, and two cars are driving over it. The surrounding area is dry and hilly.

...low cost splash

A photograph showing a silver car driving on a dirt road. A splash guard is installed on the front of the car to prevent mud from being splashed onto the road.

Problem: erosion in side drain

A photograph showing a dirt road with a deep erosion hole in the side drain. A white pickup truck is driving on the road, and a person is standing near the erosion hole.

Solution: mitre drains...

A photograph showing a dirt road with a mitre drain installed. The drain is a concrete structure that allows water to flow away from the road without causing erosion.

...and drain lining

A photograph showing a dirt road with a lined side drain. The drain is lined with concrete blocks to prevent erosion.

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Side accesses...



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...can cause side drains to overtop and erode the surface



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Solution: access structures



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Problem: flooding



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Solution: embankment



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Problem: erosion on an unformed track



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Solution: diversion banks



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Problem: surfaces can be dusty...



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...slippery...



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...badly eroded...



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...with potholes...



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Solution: gravel...



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...seals...



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...spot sealing...



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...geo cells



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And if the road or track is passable...



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...do nothing...



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...do nothing



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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




Guidance on carrying out a survey







Other survey techniques








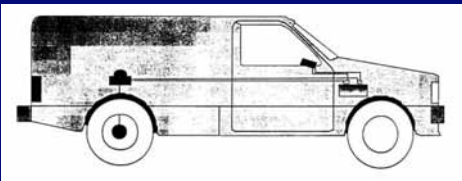
Measuring Surface Deflection








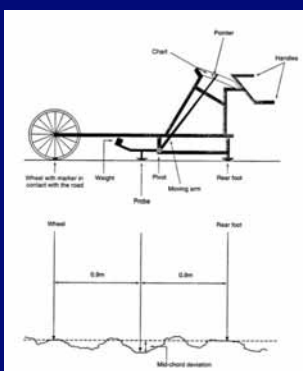


For Unpaved Primary Routes

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




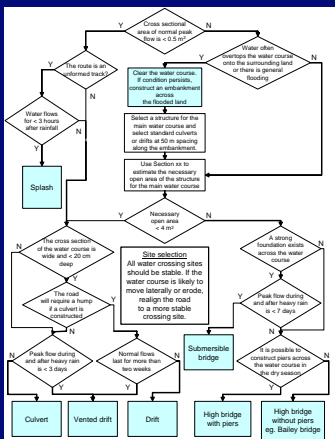



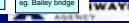


Chapter 3 – Select appropriate solutions


- 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 Sites Críticos

Id. do Site	Nome do Site	Localização	Descrição	Impacto	Medidas de Mitigação	Responsável	Observações
001
002
003
004
005
006
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098
099
100




Completed plan

Figura 5 - Mapa de Localização de Melhoramentos Localizados

Tipo de Melhoramento	Localização	Km									
		0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
Pavimento de base com brechas e pedras > 2 cm	Localização (km)	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
	Quantidade	100	100	100	100	100	100	100	100	100	100
Linhas de Água	Localização (km)	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
	Quantidade	1	1	1	1	1	1	1	1	1	1
Sítios, Superfícies e Abrigamentos	Localização (km)	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
	Quantidade	1	1	1	1	1	1	1	1	1	1
Drenagens e Taludes	Localização (km)	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
	Quantidade	1	1	1	1	1	1	1	1	1	1



Chapter 8

Catalogue of solutions

Alternatives
Descriptions
Sketches
Drawings
Quantities

Solução	Código	Norma
Secção A - Estruturas de Linhas de Água		
Estimativa de tamanho de estrutura	A0	
Aplicação	A1	
CMF simples	A2	
CMF de pedra estruturada	A3	
CMF de cimento	A4	
Paralelepípedos de pedra	A5	
Paralelepípedos de cimento	A6	
Paralelepípedos	A7	
Paralelepípedos	A8	
Paralelepípedos	A9	
Paralelepípedos	A10	
Paralelepípedos	A11	
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Paralelepípedos	A94	
Paralelepípedos	A95	
Paralelepípedos	A96	
Paralelepípedos	A97	
Paralelepípedos	A98	
Paralelepípedos	A99	
Paralelepípedos	A100	

Estimating the size of a structure...

Rational method

Terreno	C1	Solo	C2	Vegetação	C3
Muito plano	0.10	Arenoso	0.15	Densa	0.25
Ondulado	0.14	Médio	0.21	Médio	0.35
Montanhoso	0.20	> 30% rocha	0.30	Nenhuma/alguma	0.50
		pavimentação			

$C = C1 + C2 + C3$

Tabela 17 Calculando C para a captação de chuva

C	Área de captação (ha)	Área aberta necessária (m ²)
0.50	< 5	0.3
	5-10	0.2
	10-20	0.2
	20-50	1.6
	50-100	2.5
0.50 - 0.75	100-200	4.9
	200-500	7.2
	< 5	0.5
	5-10	0.8
	10-20	1.2
0.75 - 1.00	20-50	2.3
	50-100	3.6
	100-200	6.9
	200-500	11.0
	5-10	1.0
10-20	1.7	
20-50	3.0	
50-100	5.0	
100-200	9.0	
200-500	14.0	

Tabela 18 Área aberta necessária para uma estrutura de...

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	Press-dia	20
Capataz	Press-dia	2
Pedreiros	Press-dia	3
Tractor	Equip-dia	2
Atrelado	Equip-dia	2
Tanque de água	Equip-dia	10
Betoneira	Equip-dia	10

Drift

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Splash

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Vented drift

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Embankment Construction and Repair

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Submersible bridge

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High bridge

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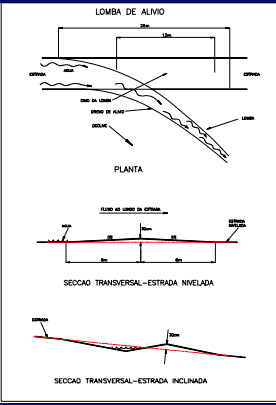
Prevention of erosion

- 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

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Diversion banks to prevent erosion on a track

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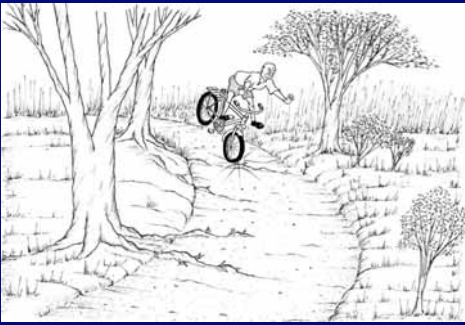
Removal of anthill



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Removal of roots



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Separate track



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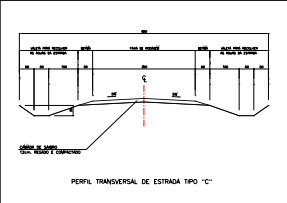
Sustainability in the UK!



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Road formation

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Road on rock

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Drains, mitre drains and scour checks

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Side access

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Bio-engineering

Vegetation on slopes
 Stone paving
 Live scour checks
 Vegetation fascines

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Grass cutting, bush clearing & tree removal

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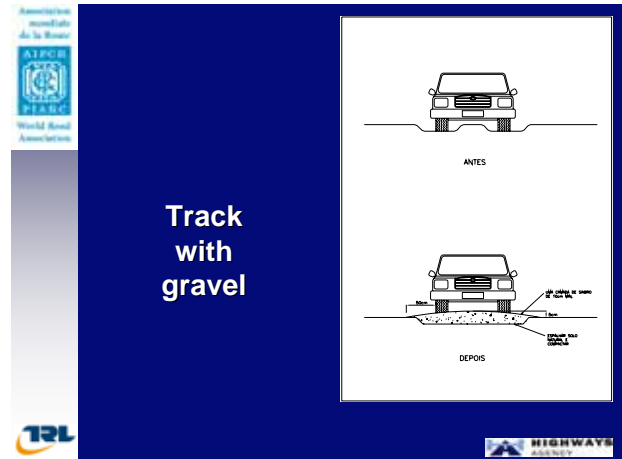
Improved surfaces

Slippery
 Erosion
 Loose sand
 Dusty
 Weak
 Swampy
 Rock outcrops

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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	Otta seal simples Grit seal
Menos de 50	Bons materiais naturais disponíveis Declive íngreme	Saibro	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



Gravelling

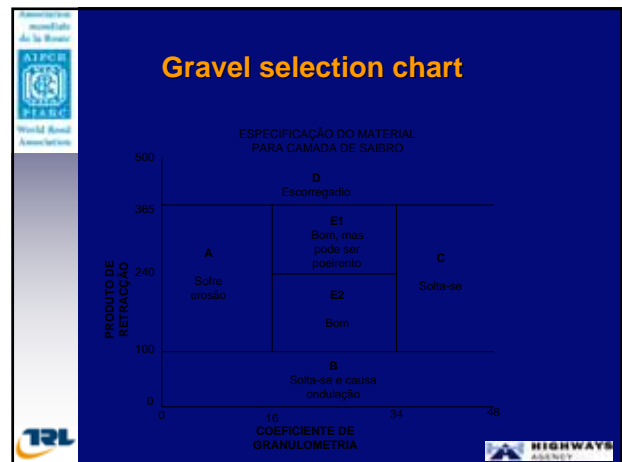
Gravel tests

Grading coefficient

Shrinkage product

Settlement test

Drying test



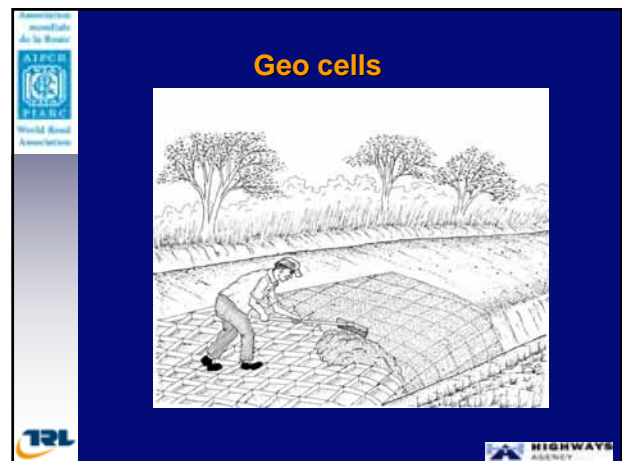
Bituminous seals

Sand seal – area

Grit seal – 0-6 mm

Otta seal – 0-16 mm

Chip seal – 10 ou 13 mm



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
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