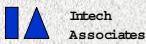


PIARC Rural Transport Seminar  
Cambodia - May 2002

## Rural Road Surfacing Investigations

by Robert Petts



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1

## The Presentation

- The Context of the road surfacing investigations
- Gravel surface characteristics & constraints
- Some proven alternatives
- Economic issues
- Making the right choice of road surface



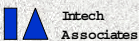
2

## Context of the Surfacing Studies

- Over 30 years of focus on gravel as the main option for low cost rural access solutions
- Current concerns that gravel is not the most appropriate surface in some circumstances
- Natural gravel resource depletion
- Universal problems of maintenance capacity

→ DFID agreement to finance Rural Road Surfacing Investigations 2000 - 2003

→ International Guidelines to be developed



3

## Gravel Surfacing is widely used for low volume roads

However, Gravel may not be appropriate, especially where :-

- Gravel quality is poor (inc. standards compliance)
- Compaction & thickness cannot be assured
- Haul distances are long
- Rainfall is very high, or dry season dust problems
- Traffic levels are high
- Longitudinal Gradients > 6% (medium - high rainfall)
- Adequate maintenance cannot be provided
- Sub-grade is weak or soaked (flood risk), or
- Gravel deposits are limited/environmentally sensitive



4

## Poor quality gravel

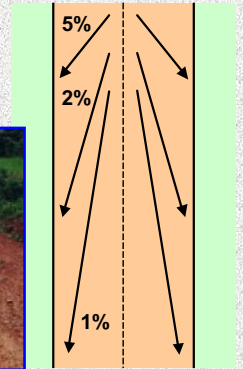
Scarcity of good gravel or lack of quality control can lead to the use of poor gravel materials.



## Steep gradients

Lead to high gravel loss unless the surface is regularly maintained .....

Path of rainwater shown for various crossfalls for 7% longitudinal gradient



## In some circumstances Gravel surfacing :-

- Leads to high rates of gravel loss – even with good material
- Causes an expensive burden of typically 3 – 5 year regravelling cycles in many countries
- Causes a high risk of route impassability if regravelling is not carried out in time

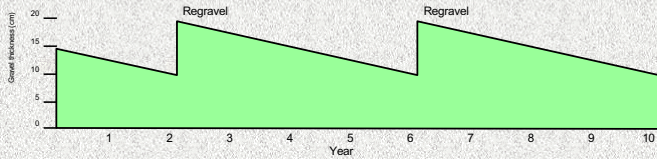
.....from serviceable to failure condition in one wet season.

## Gravel deteriorates rapidly if not maintained



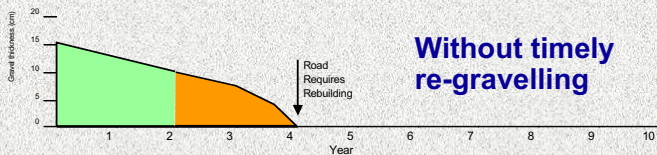
Without timely grading.....

Figure 1-1 - GRAVEL THICKNESS **WITH** PREVENTATIVE MAINTENANCE (Including timely re-gravelling)



Sustainability of gravel surfacing is particularly dependent on timely availability of considerable financial & physical resources at frequent intervals for regravelling. Many road authorities/communities have difficulty in achieving this.

Figure 1-2 - GRAVEL THICKNESS **WITHOUT** PREVENTATIVE MAINTENANCE (No timely re-gravelling - investment is lost!)



NOTE: Based on deterioration rates predicted for lateritic gravel roads, hilly, high rainfall (2,000 mm/year) with traffic of 20 vpd by TRRL Laboratory Report 1111 and incorporated in RTIM. Use of poor quality material will cause even faster rates of gravel loss.

## Gravel roads are particularly susceptible to flood damage

A single flood can result in the need to reconstruct



## Some Proven Surfacing Options

- Maintained Earth Road (higher CBRs)
- Natural Gravel / Laterite
- Lime Stabilization of Earth Road
- Hand Packed Stone
- Dressed Stone
- Stone Setts
- Concrete Blocks
- Clay Bricks

Refer to LCS Working Paper No 1

## Some More Proven Surfacing Options

- Bamboo Reinforced Concrete
- Steel Reinforced Concrete
- Bituminous Sand Seal
- Ottaseal
- Bituminous Surface Dressing (Chip Seal)
- Bituminous Slurry Seal (& 'Cape' Seal)
- Premix Macadam
- Penetration Macadam



## Hand Packed Stone



### ADVANTAGES

- Suited to labour-based small contractor/community approach.
- Erosion resistant, durable, and easily repairable.
- Not constrained by gradient.
- High residual value on materials.

### DISADVANTAGES

- Stone shape and strength critical.
- Medium – high surface roughness.

## Dressed Stone



### ADVANTAGES

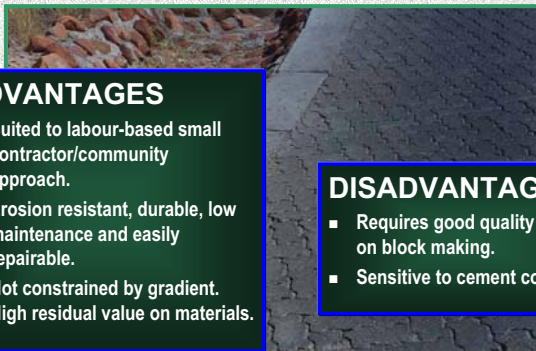
- Suited to labour-based small contractor/community approach.
- Erosion resistant, durable, and easily repairable.
- Not constrained by gradient.
- High residual value on materials.



### DISADVANTAGES

- Stone shape and strength critical.
- Medium surface roughness

## Concrete Block



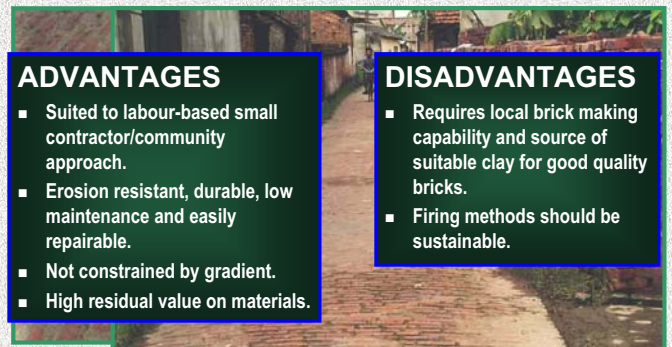
### ADVANTAGES

- Suited to labour-based small contractor/community approach.
- Erosion resistant, durable, low maintenance and easily repairable.
- Not constrained by gradient. High residual value on materials.

### DISADVANTAGES

- Requires good quality control on block making.
- Sensitive to cement costs

## Clay Brick



### ADVANTAGES

- Suited to labour-based small contractor/community approach.
- Erosion resistant, durable, low maintenance and easily repairable.
- Not constrained by gradient.
- High residual value on materials.

### DISADVANTAGES

- Requires local brick making capability and source of suitable clay for good quality bricks.
- Firing methods should be sustainable.

## Bituminous Sand Seal



### ADVANTAGES

- Good service record in some regions when regularly maintained.
- Can be used as a low cost maintenance treatment on some surfaces.

### DISADVANTAGES

- Requires smooth sound tight road-base.
- Requires regular maintenance.
- Requires bedding-in.
- Requires skilled operatives.

## Bituminous Surface Dressing (Chip Seal)



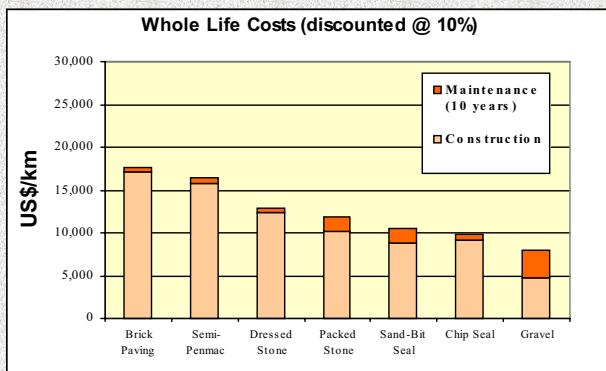
### ADVANTAGES

- Widely used intermediate technology option.
- Good performance record if well constructed (seal life typically 4-14 years).
- Can be used as a low cost maintenance treatment on some other surfaces.

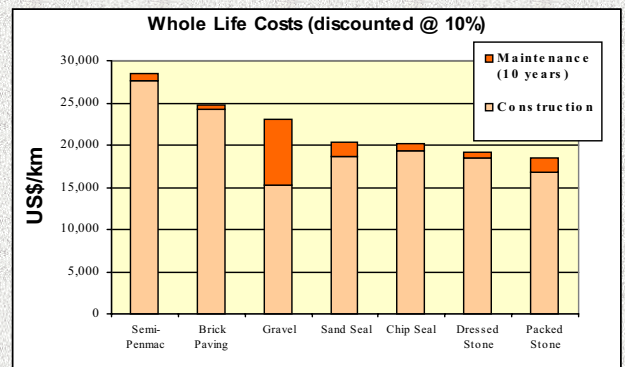
### DISADVANTAGES

- Good construction control on road base preparation and on binder & aggregate spreading.
- Suitable supply of quality aggregate.
- Requires skilled operatives

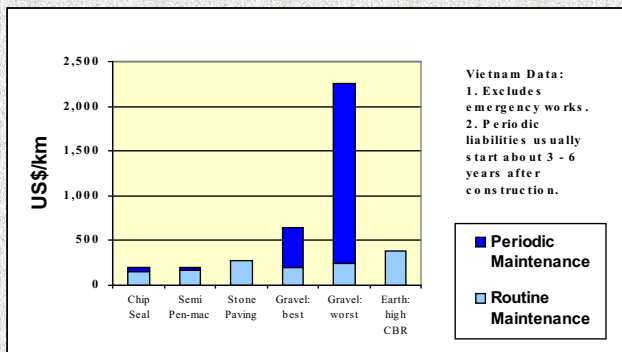
## Example Whole Life Costs – Short Haul Scenario



## Example Whole Life Costs – Long Haul Scenario



## Rural Road Network – Example Annual Funding Required



## Rural Road Surfacing Choice should take account of:-

- ❑ User's transport needs (foot, NMT, motor vehicle)
- ❑ Appropriate standards and specifications
- ❑ Availability of local resources & costs
- ❑ Local road conditions – subgrade, road environment
- ❑ Flood risk
- ❑ Traffic characteristics and loading
- ❑ Maintenance regime
- ❑ Finance and other resources available
- ❑ Technical and implementation options
- ❑ Environmental & Social considerations
- ❑ Whole Life Cost considerations

## Current Research confirms .....

Gravel / Laterite is a  
**“Low Initial Cost – High Maintenance”  
 Surface**

Use it  
 with care!

**‘Government Health Warning’**



**Full details of the research findings, documentation and guidelines for downloading will be available on the DFID Transport Links website:-**

**[WWW.transport-links.org](http://WWW.transport-links.org)**

**Project KaR 7782:  
 Low Cost, Labour Based Paved  
 Roads for Poor Communities**