PIARC Rural Transport Seminar
Cambodia - May 2002

Rural Road Surfacing Investigations

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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

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

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

Poor quality gravel

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

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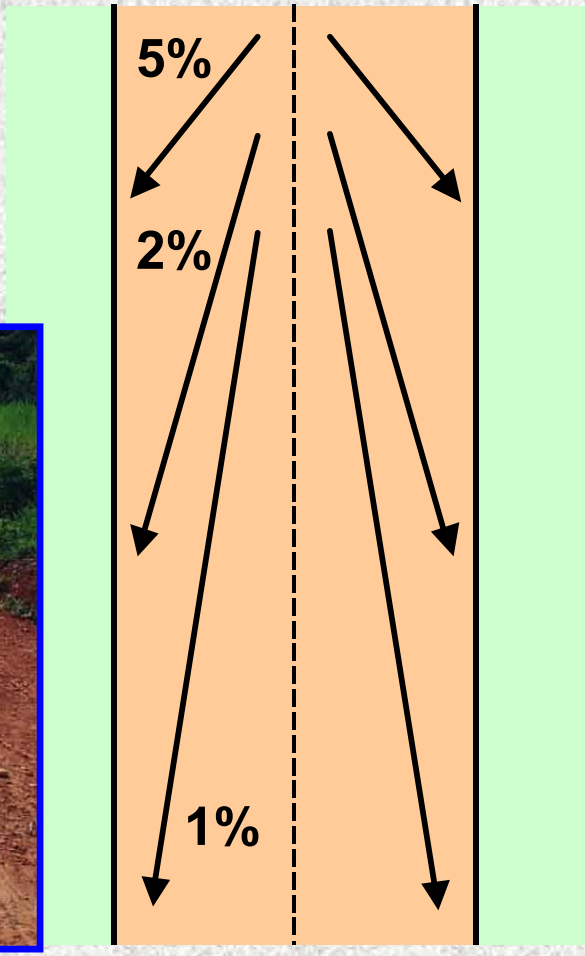
Steep gradients

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

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



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In some circumstances Gravel surfacing :-

- Leads to high rates of gravel loss – <u>even with good material</u>
- 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……

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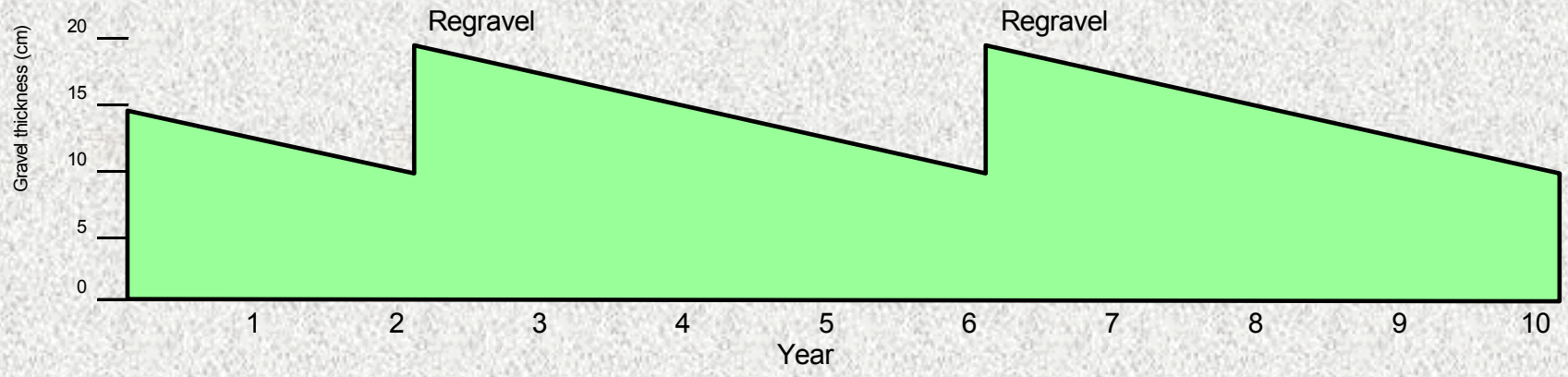
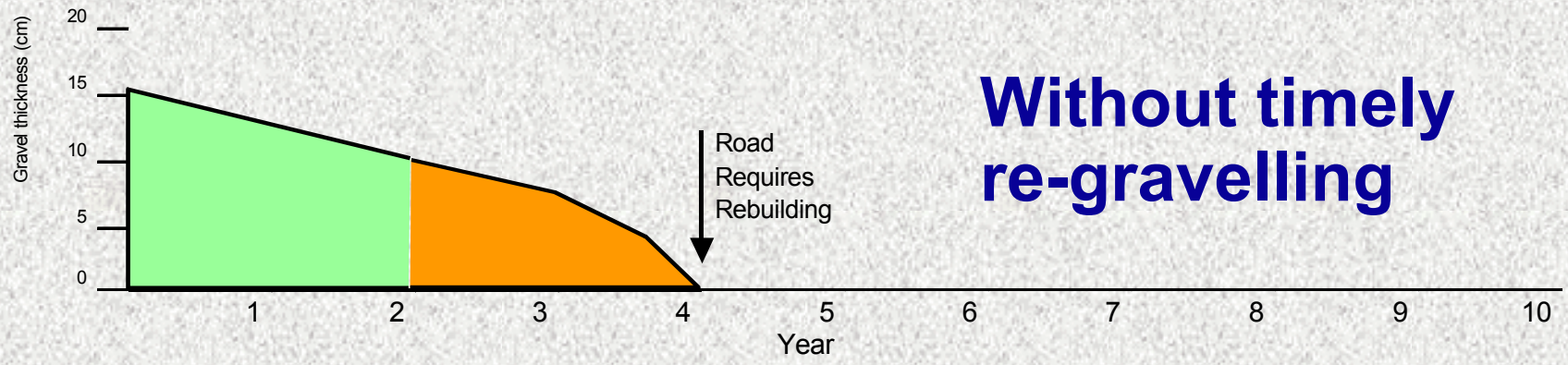
Figure 1-1 - GRAVEL THICKNESS **WITH** PREVENTATIVE MAINTENANCE (Including timely re-gravelling)



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

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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

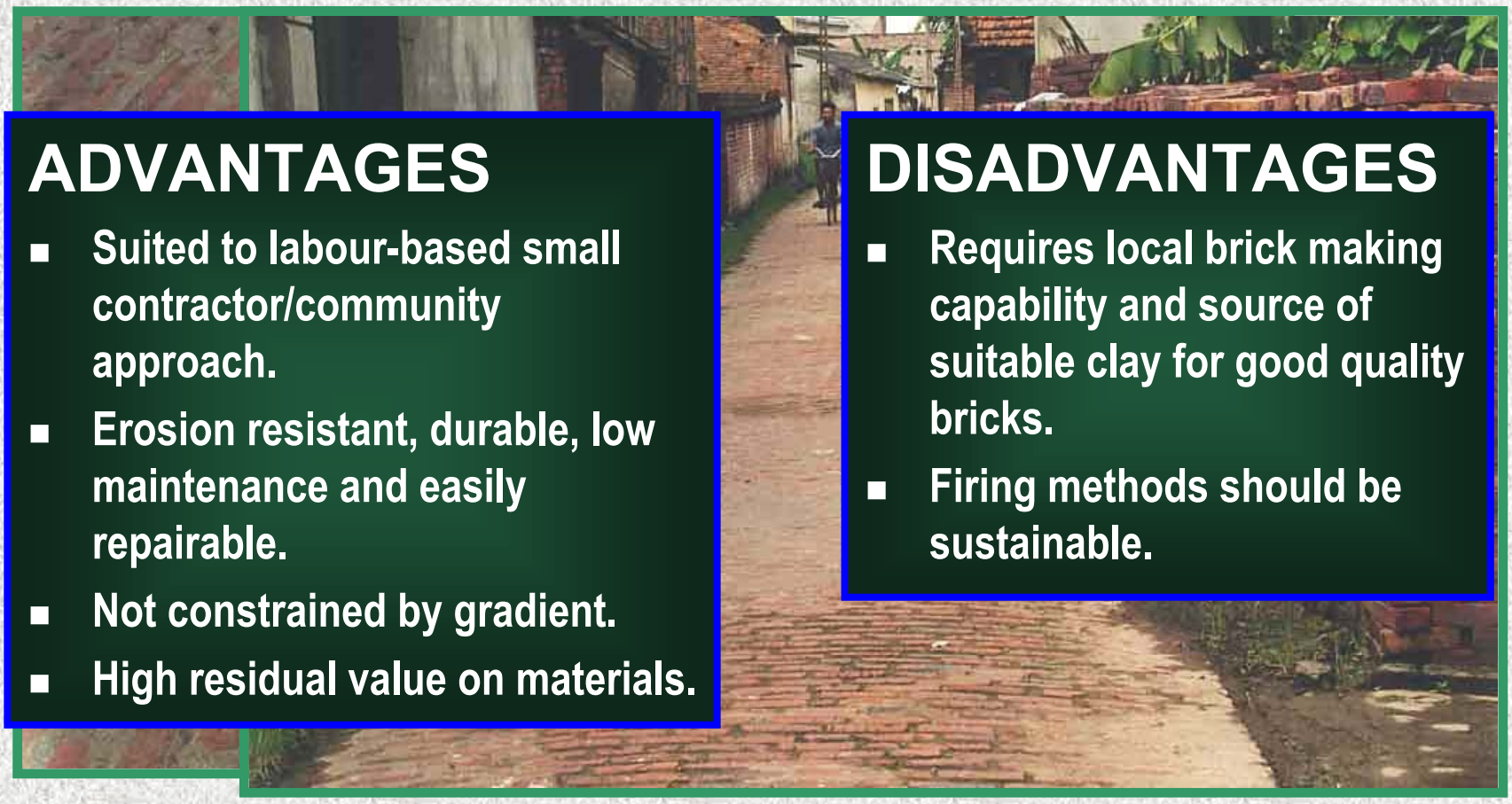
ADVANTAGES

- 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

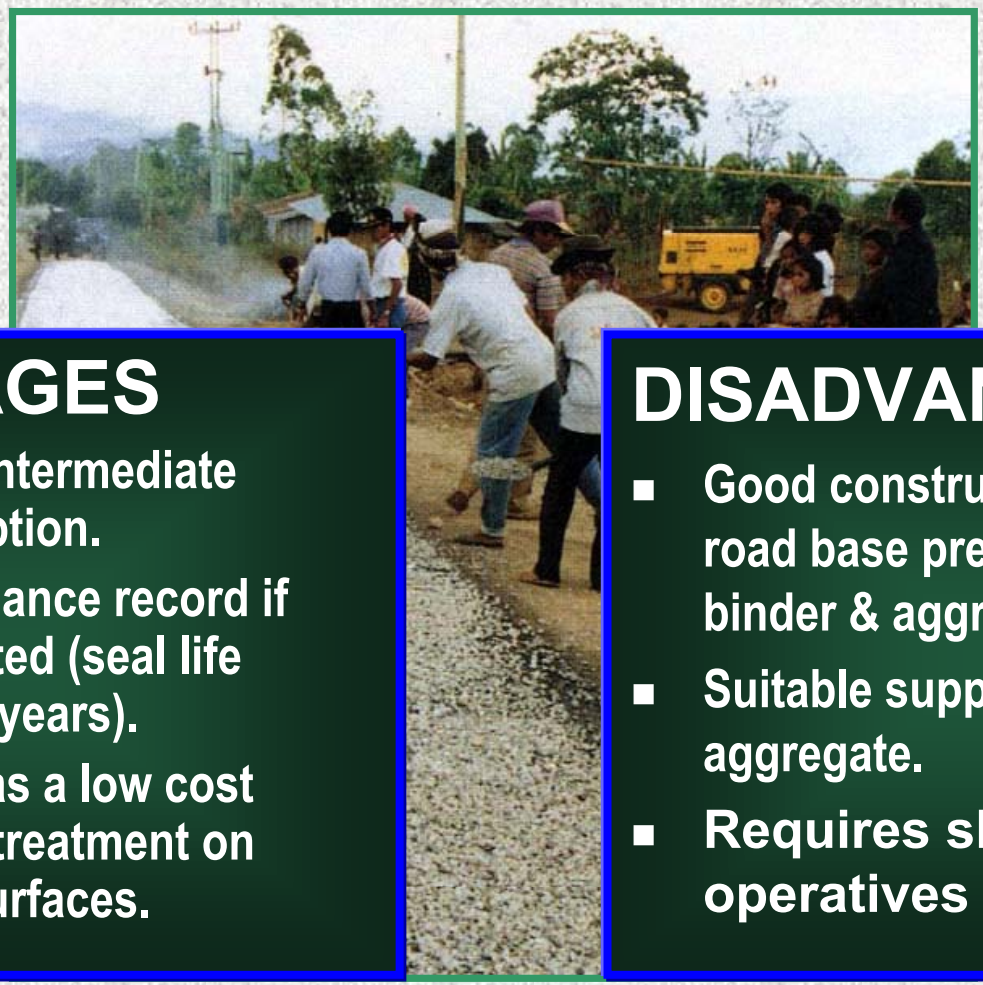
ADVANTAGES

- 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)



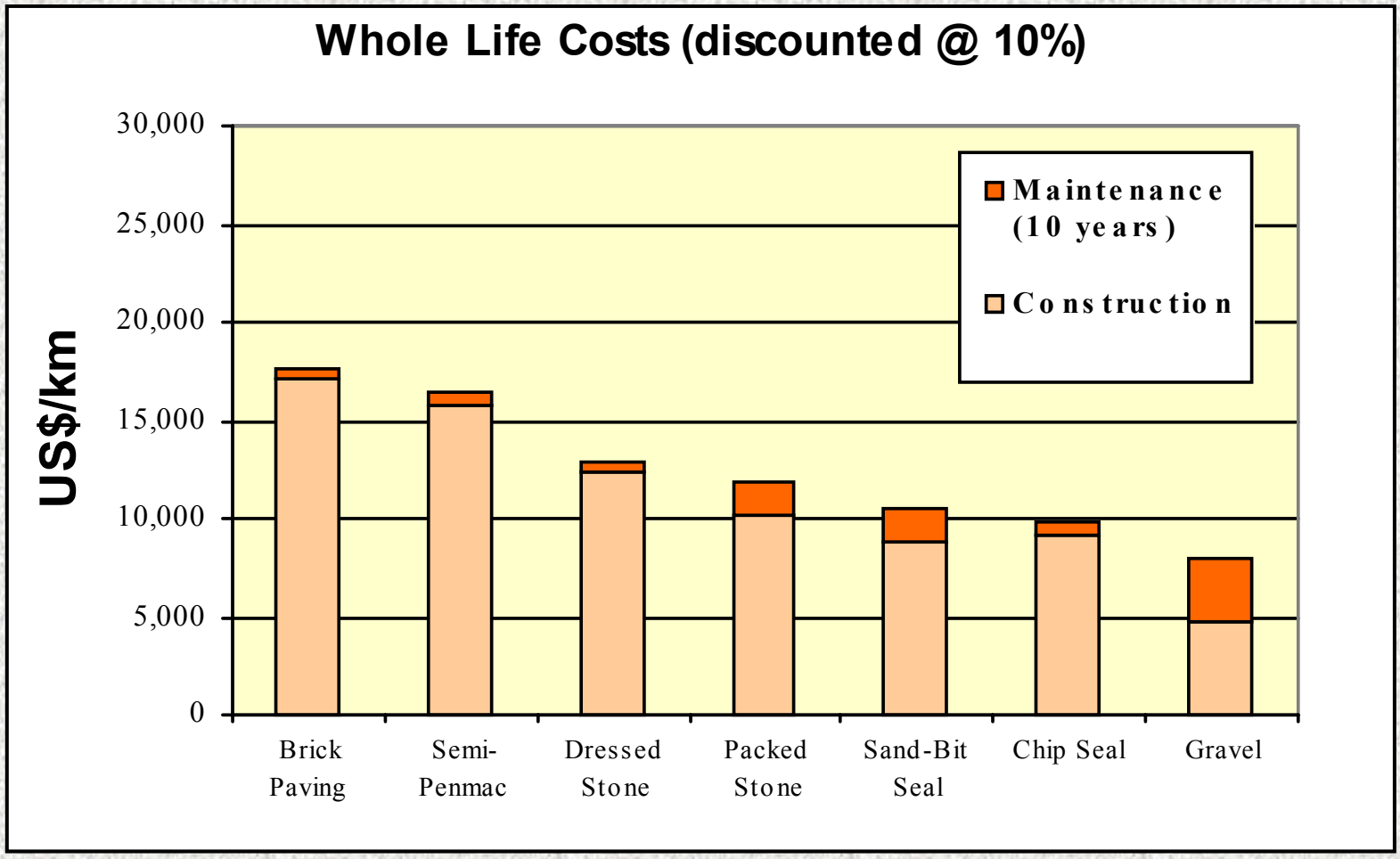
ADVANTAGES

- 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



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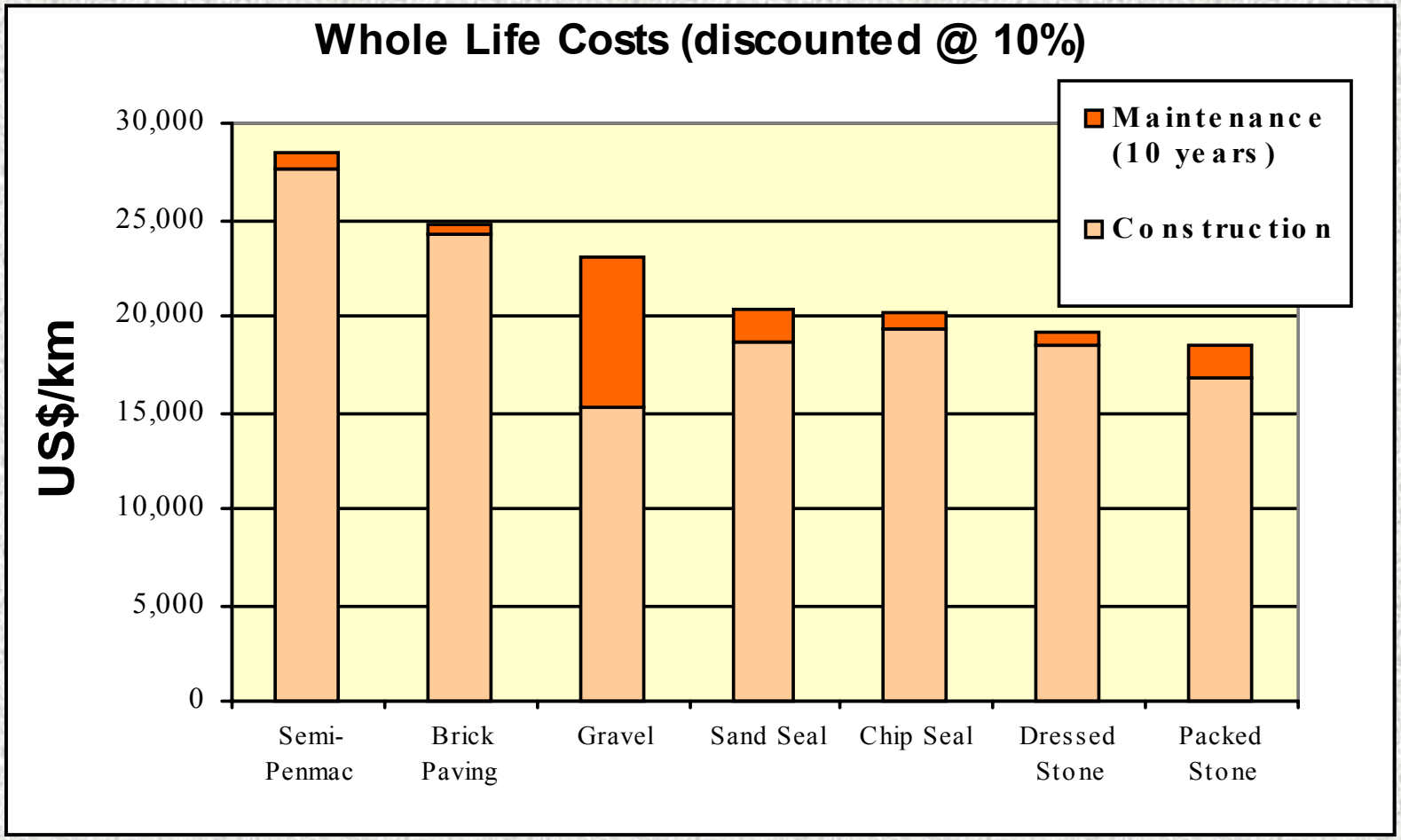
Example Whole Life Costs – Long Haul Scenario



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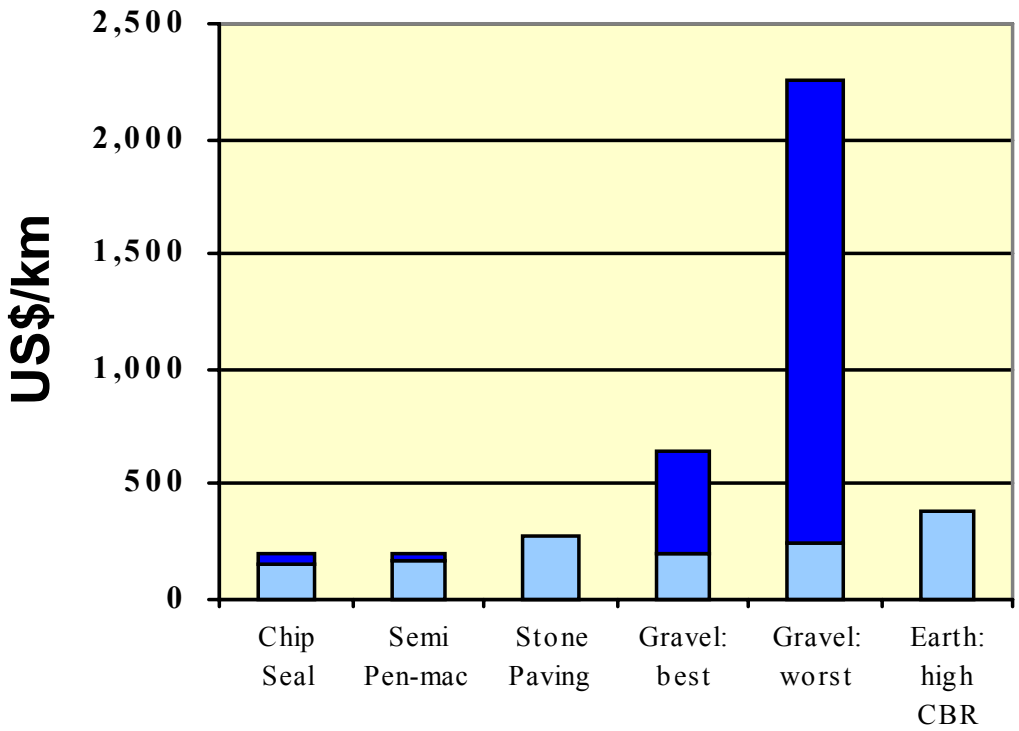
Rural Road Network – Example Annual Funding Required



Vietnam Data:
1. Excludes emergency works.
2. Periodic liabilities usually start about 3 - 6 years after construction.

- Periodic Maintenance
- Routine Maintenance

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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

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

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