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Appropriate Surface Sealing for Sustainable Low Volume Rural Roads in Vietnam

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Presentation Focus

Context: Rural Road Surfacing Research (RRSR) programmes for basic rural access

Research: Vietnam Rural Road Surfacing Trials

Practical application; Environmentally Optimised Design – Spot Improvements

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SEACAP: Improved Sustainable Access to Rural Communities,.

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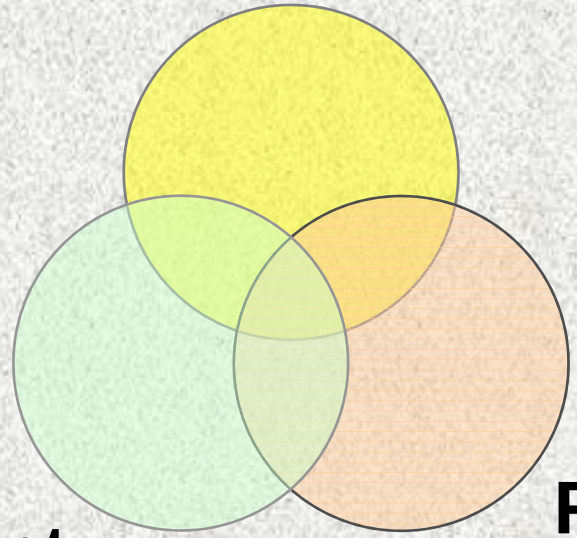
Available Materials



Road Environment

Road Task

SUSTAINABLE RURAL ROADS

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SEACAP research highlighted a serious mis-match between the design options currently being used; the road environment; road tasks and the materials being used to construct them.

A particularly challenging environment for unpaved roads

Poor Materials

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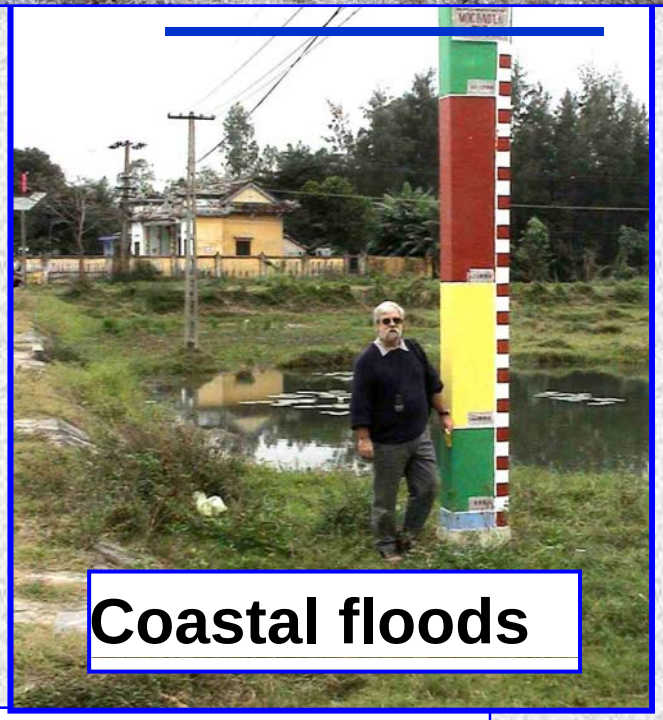
Erosive high rainfall

Variable terrain

Poor maintenance



Coastal floods

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Control Section

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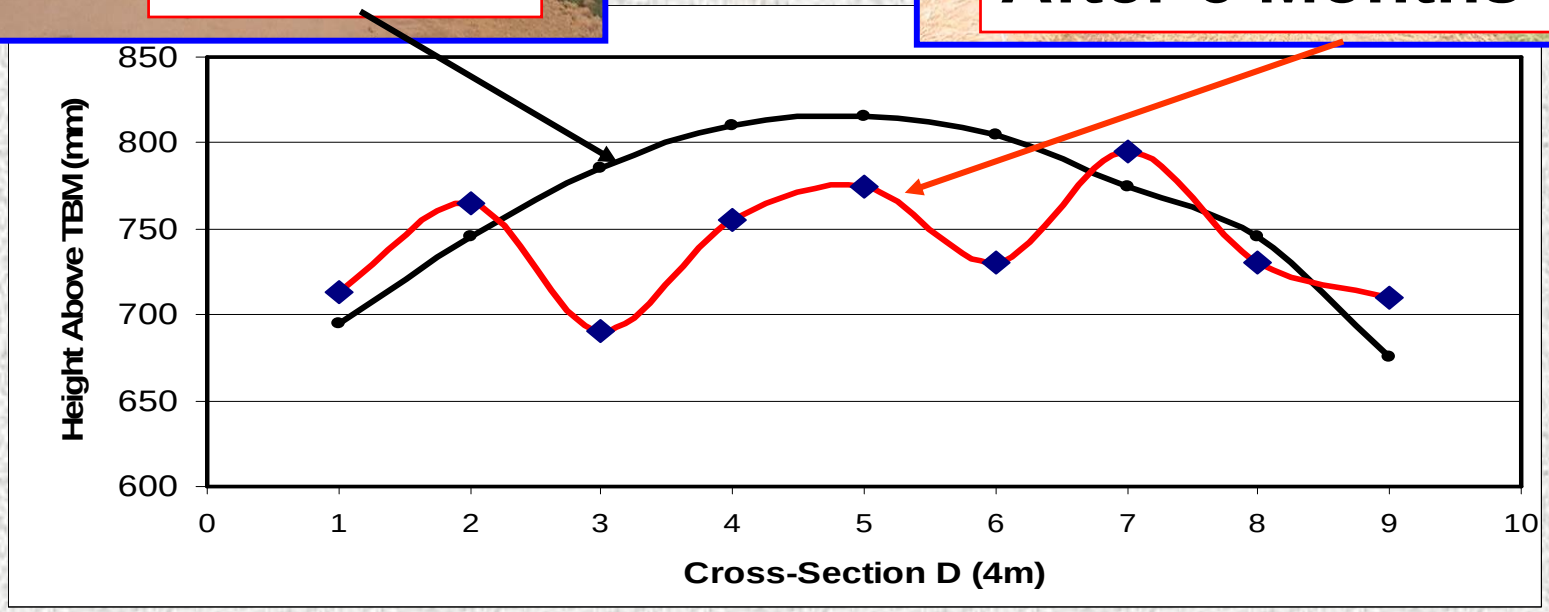

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The UK Department for International Development (DfID) and World Bank has co-fund research into appropriate alternatives to the use of unsealed gravel surfacing

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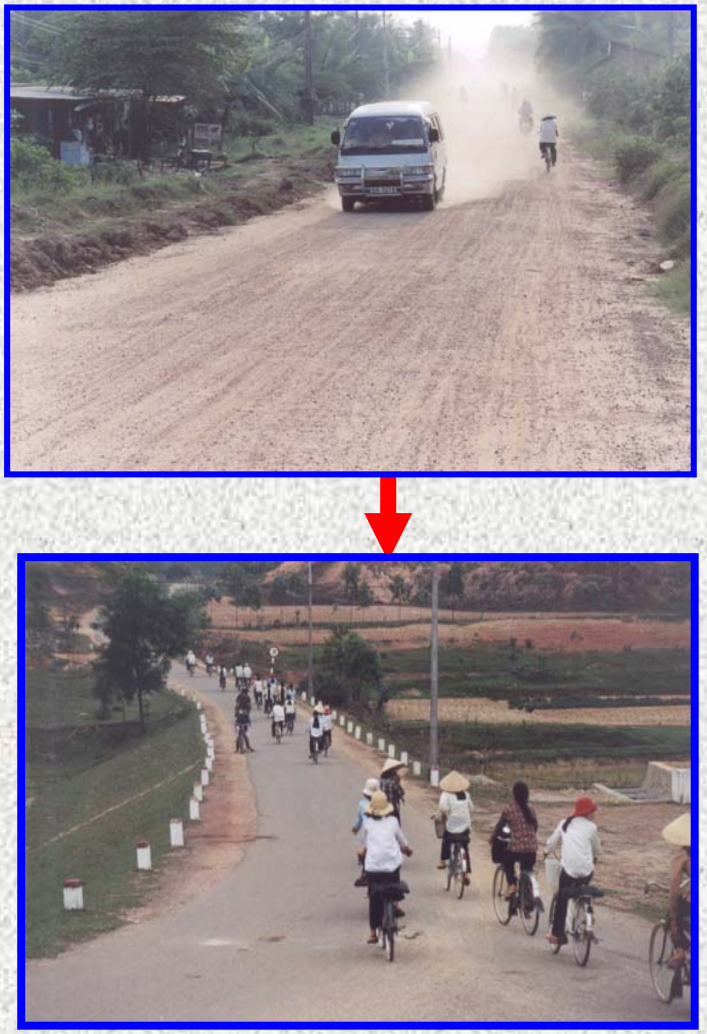
In Vietnam two Rural Road Surfacing Research trial programmes carried under the guidance of the MoT Steering Committee and SEACAP.



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41 trial roads in 12 provinces completed between May 2005 and June 2006.

- **Appropriate to the road environments.**
- **Local construction materials**
- **Sensible Maintenance requirements**

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	Vehicles Per Day		
	Motor Vehicles	Motor-Cycles	Cycles
Mekong Delta	0	1718	1085
	2	1110	646
Central Highlands	101	134	1064
	176	1150	106
	277	469	56
Northern Highlands	101	907	1025
	20	266	726
	148	1249	1304
	31	540	305
	67	572	776

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Bitumen emulsion sealed surface trialled in comparison with hot bitumen

- Better suited to labour oriented construction
- Suitable for village based maintenance operations
- Better site control on small rural contracts

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Range of Sealed Pavement Options

- Armoured gravel
- Waterbound macadam
- Drybound macadam
- Graded crushed stone
- Lime stabilised soil
- Cement stabilised sand
- Clay bricks
- Concrete bricks

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A total of 66 sealed trial sections (100-200m) are being monitored:

Emulsion seals:

- Double stone chip seals (DBEST); - 23
- Single stone chip + sand seal (SBEST+ESS); - 8
- Single sand seal (ESS); - 8

Standard Vietnamese options:

- Hot bitumen double stone chip seal (DBST), - 18
- Hot bitumen penetration macadam (PenMac), - 7
- Hot bitumen triple stone chip seal - 2

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Emulsion seals have performed as well as hot bitumen and penetration macadam surfacing.

Some cracking in seals on lime stabilised bases associated with the roadbase problems rather than the seals themselves.

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- Single ESS on clay and concrete bricks is showing signs of wear and cracking
- Some road deterioration due to gross traffic overloading in one province

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Typical Costs: Vietnam

	DBEST Cost/m2	DBST Cost/m2	DBEST over Waterbound Macadam Cost/km	Gravel Cost/km
Northen Highlands	$2.18	$2.50	$18,590	
Central Coast	$2.63	$2.26	$21,220	$2,800
Red River Delta	$3.27	$4.06	$24,900	
Mekong Delta	$1.69		$24,400	$6,955
Central Highlands	$2.57		$29,400	$3,200
Costs in US$ Cost/km calculated on a 3.5m wide carriageway				

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Whole-life Asset Costs

Typical Example - Hill region of N Lao with:

4% gradient; 2000mm rain/yr; 50-100 VPD
sub-grade CBR 7%; 6T axle load

Costs US$/kilometre of pavement (3.5m)

	Construction	Construction + Maintenance	NPV Total Cost
Unsealed Gravel	$5,000.00	$52,869.00	$31,632.00
Sealed Dry-bound	$18,000.00	$30,826.00	$23,751.00

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Practical application; Whole-Life Costed & Environmentally Optimised Design (EOD)

Utilising the available resources of budget and materials in the most cost-effective manner.

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EOD a spectrum of solutions for improving volume rural access – Spot Improvement to Variable Longitudinal Design

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Sealed surfaces: a cost-effective alternative within the EOD framework.

Bitumen emulsion options, are particularly attractive in this regard .

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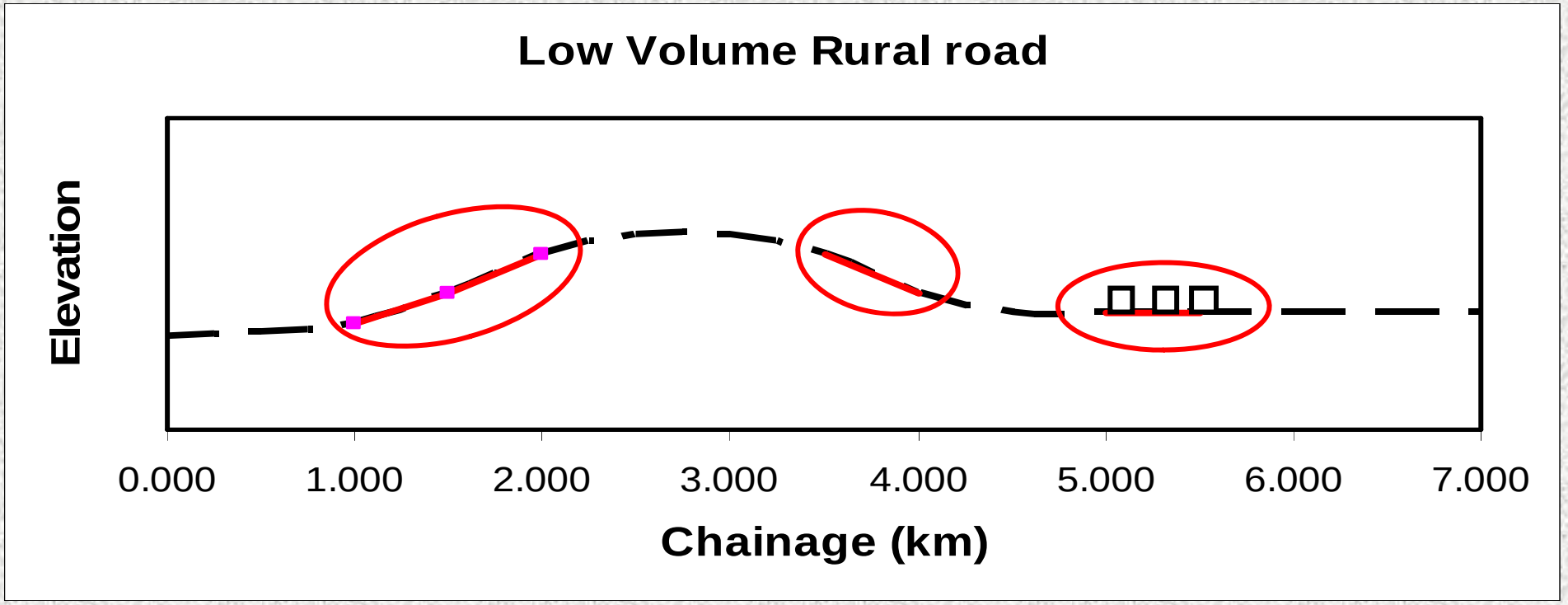

Option	Km	Design	Construction Cost only US$/km	Total Cost
1	7	Gravel	$5,000	**$35,000**
2	7	Sealed Macadam	$18,000	**$126,000**
3	5	Gravel	$5,000	$25,000
	2	Sealed Macadm	$18,000	$36,000
			Total EOD	**$61,000**

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Two key outcomes within the Low Volume Rural Road sector in S E Asia

The use of natural gravel as an unsealed road surface has been shown to be unsustainable in many circumstances .

The appropriate use bituminous surface seals, has been demonstrated as being cost-effective and sustainable .