

# Rural Road Surfacing Trials Programme (RRST)

## *RRST Cost Norms and Whole Life Costing Model*

*Pham Gia Tuan, Robert Petts and Jasper Cook*



# RRST Cost Norms

## Reasons to introduce the cost norms:

- ❑ Cost norms of some new surfacing options introduced under RRST programme are not currently available in Viet Nam
- ❑ RRST programme has researched the specific characteristics of these new options



e.g. Construction of lime stabilised roadbase

# RRST Cost Norms

## Basis for building the RRST cost norms:

- ❑ **Basic Construction Norms number 1242/1998/QD-BXD**
- ❑ **Repair Norms for Basic Construction number 29/2000/QD-BXD**
- ❑ **Road and Bridge Norms number 79**
- ❑ **Basic Construction Material Norms number 22/2001/QD-BXD**
- ❑ **Labour Norms Used during Construction by ILO, 1998**
- ❑ **Review of international experience**

# RRST Cost Norms

## Main Content:

**RRST Cost norms have been developed and used based on the following principles:**

- ❑ **New cost norms have been created for the special cases**
- ❑ **Some related available cost norms have been used without any adjustment**
- ❑ **Some related available cost norms have been adjusted to fit the new construction techniques and trial characteristics**
- ❑ **Comments have been collected from the stakeholders, especially from PDoTs & Local Consultants**

# RRST Cost Norms

The Available cost norms have been used for the following activities:

- ❑ **Activity 33: Shoulder Drainage Layer**
- ❑ **Activity 34: Sub-surface Drainage**
- ❑ **Activity 36: Gravel Sub-base**
- ❑ **Activity 42: Sand Bedding Layer**
- ❑ **Activity 46: Penetration Macadam Layer**
- ❑ **Activity 51a, 52a and 55a: Concrete Pavement**
- ❑ **Activity 52b: Steel Reinforcement**
- ❑ **Activity 51d, 52d and 55c: Formworks Installation and Re-installation**

# RRST Cost Norms

New cost norms have been developed for the following activities:

- ❑ **Activity 35a: Natural Gravel Shoulders**
- ❑ **Activity 35b: Lime Stabilised Shoulders**
- ❑ **Activity 35c: Cement Stabilised Shoulders**
- ❑ **Activity 37a & 37b: Lime Stabilised Base/Sub-base**
- ❑ **Activity 38a & 38b: Cement Stabilised Base/Sub-base**
- ❑ **Activity 40: Dry Bound Macadam Base(s)**
- ❑ **Activity 41a: Amoured Natural Gravel Layer**
- ❑ **Activity 44 & 45: Sand and Chip Seal Layer(s)**

# RRST Cost Models

## Introduction

### General:

- ❑ Can be used as a support tool for Rural Road Authorities to select the most appropriate surfacing options for the local road environments.
- ❑ Two types of Whole Life Cost model for rural roads:-

**Asset**

to  
minimise

**Construction  
Costs**

+

**Maintenance  
Costs**

**Transport**

to  
minimise

**Construction  
Costs**

+

**Maintenance  
Costs**

+

**VOCs**

# RRST Cost Model

## Functions

### Construction Costs

Incorporates the RRSR knowledge of the range of surfaces trialed



### Maintenance Costs

Incorporates RRGAP and preliminary maintenance assessment



### VOCs

Model capable of development to incorporate local VoC knowledge

***Further research required – RRST long term maintenance monitoring and local VOCs to develop robust full transport model***

# RRST Cost Model

## Benefits

- Valid for all regions and conditions in Vietnam
- Predicts construction and estimates maintenance costs for each rural road surface option
- Demonstrates the effects of a wide range of influential factors
- Demonstrates the important influence of materials haul distance
- Demonstrates the constraints to cost-effective use of gravel
- Will be simple to upgrade to incorporate VOC sub-model

# RRST Cost Model

**Format:** Excel spreadsheet based

**Model inputs:**

- **Natural factors – Usually Uncontrollable**
  - **Sub-grade geological and hydrological conditions: types of soil, strengths, flood regime**
  - **Longitudinal gradient**
  - **Terrain (mountainous, midland, plain....)**
  - **Annual rainfall (impacts to the deterioration rate of some types of pavement)**
  - **Material sources and haulage distance to the sites**

# RRST Cost Model

## Model inputs:

- ❑ **Manmade factors - Controllable**
  - **Traffic flow**
  - **Axle loads**

## Expected outputs for selected surface options:

- ❑ **Construction costs of the selected option per km (with defined surface width)**
- ❑ **Maintenance costs per km (15 year period) in terms of present cost**
- ❑ **Maintenance costs per km (15 year period) in terms of Net Present Value.**

# RRST Cost Model

## Types of pavement

- ❑ There are currently 27 pavement options that may be selected within the model.
- ❑ All options proven in Vietnam/elsewhere
- ❑ Construction trials and preliminary maintenance assessment for Vietnam under RRST-I and RRST-II
- ❑ Model incorporates residual value assessment



# RRST Cost Model

## Model function

### Input and Output screen:

- ❑ Tools to input the data and select the road environment parameters, material prices and haulage distances
- ❑ The related information of the selected pavement option such as construction cost, maintenance costs and whole life costing chart etc. will be displayed on the same page
- ❑ The page also provides the notices and recommendations for using different pavement options for the selected road environments.

# RRST Cost Model

## Input & Output Screen

### Road Environment factors and the recommended road pavement

Province: **Dong Thap**

Traffic		Road environment			Gradient Condition	Local soils	MOT Road Classification	Type of Pavement	Pavement Structure	Thickness of Layers	Width
I	2.5	SG Strength	Flood	Annual Rainfall	< 4%	SS	B1	C26	Natural gravel surface Natural gravel sub-base	12 12	3.5 4
Use recommendation of Pavement		F.Code	AR.Code	G.Code	LS.Code	Mt.ce group					
Most suitable		1	1	1	1	G6					

Area parameters affecting routine maintenance norm

Mountainous

Notice!

Parameters for using equipment

Blackish water

### Analysis results of the WLC

	USD
Costruction Cost	3056

Maintenance Year 1	550
Maintenance Year 2	550
Maintenance Year 3	1744
Maintenance Year 4	550
Maintenance Year 5	550
Maintenance Year 6	1744
Maintenance Year 7	550
Maintenance Year 8	550
Maintenance Year 9	1744
Maintenance Year 10	550
Maintenance Year 11	550
Maintenance Year 12	1744
Maintenance Year 13	550
Maintenance Year 14	550
Maintenance Year 15	1744

Total Maintenance Cost (yrs 1-15)	14220
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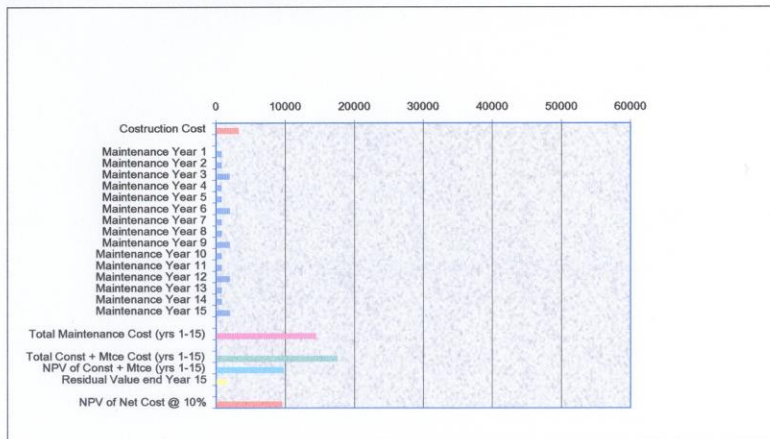
Total Const + Mtce Cost (yrs 1-15)	17276
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NPV of Const + Mtce (yrs 1-15)	9535
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Residual Value end Year 15	1312
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NPV of Net Cost @ 10%	9265
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ROAD NAME: **NATURAL GRAVEL SURFACE**



# RRST Cost Model

## Model function

### Maintenance:

- ❑ Routine maintenance adapted from available limited Norms of Viet Nam.
- ❑ It has also been necessary to add a cost sub-component for routine maintenance grading of unpaved roads.
- ❑ Periodic Maintenance of gravel roads based on RRGAP findings (no Norms available)
- ❑ Preliminary assessment of maintenance of other paving types, pending RRSR long term monitoring
- ❑ Option of assessment of no-maintenance scenario for gravel

# RRST Cost Model

## Model Function

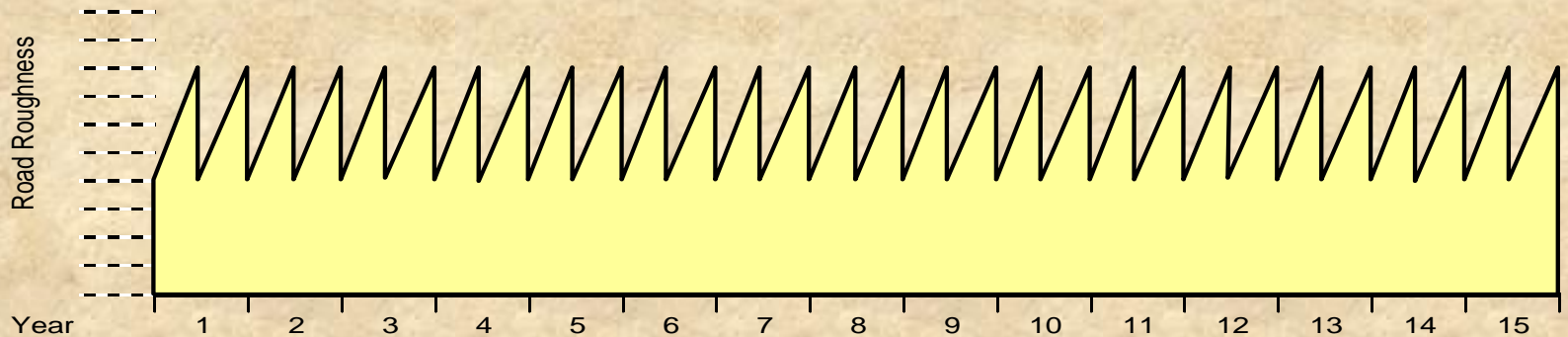
**Table 1: Annual Gravel Loss Matrix**

Terrain Region		Low delta/coastal Subject to flood	Low delta/coastal Minimal flood	Inland Flat	Rolling small hills	Hilly and mountainous
1. Basic Gravel Loss (mm/year)		40	25	30	20	35
Key Regional Factor		Poor quality material	Poor quality material	Poor quality material	Gradient	Sheet erosion (See Note I)
2. Adjustment to Basic Loss for Regional Factor		+15mm/year	+5 mm/year	+10 mm/year	2-4%: +5 mm/year 4-6%: +10 mm/year	A: +5mm/year B: +15 mm/year C: +30 mm/year
3. Further General Adjustments	3.1 Maintenance guaranteed	-30%	-30%	-30%	-30%	-30%
	3.2 Traffic Level					
	B1	+10%	+10%	+10%	+10%	+10%
	A3	+15%	+15%	+15%	+15%	+15%
	A2	+20%	+20%	+20%	+20%	+20%
	A1	+25%	+25%	+25%	+25%	+25%

# RRST Cost Model

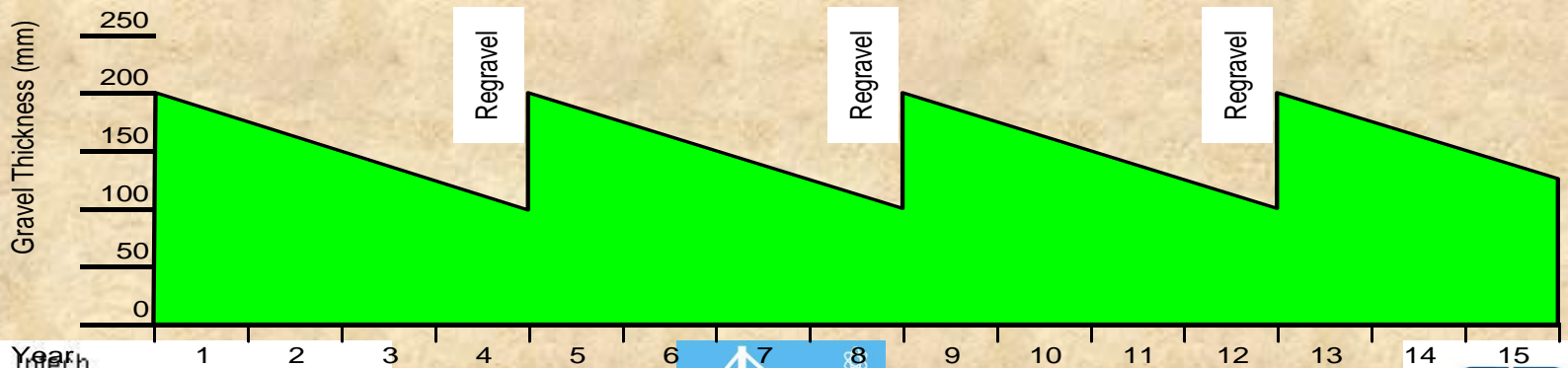
**Figure 1 - ROUTINE MAINTENANCE GRADING**

Example: 15 year analysis period, gravel road, traffic level  $< 5 \times 10^5$  PCU  
Grading twice each year



**Figure 2 - GRAVEL THICKNESS WITH TIMELY PERIODIC MAINTENANCE**

Example: 15 year analysis period, gravel road, coastal, minimal flood, with maintenance, traffic level A2  
Gravel loss: approximately 25mm/year



# RRST Cost Model

## Paving Options



Code	Type of road surfaces
C1	Steel reinforced concrete on Natural gravel sub-base
C2	Steel reinforced concrete on Lime stabilised sub-base
C3	Steel reinforced concrete on Cement stabilised sub-base
C4	Steel reinforced concrete on sand sub-base
C5	Bamboo reinforced concrete on sand sub-base
C6	Bamboo reinforced concrete on Lime stabilised
C7	Bamboo reinforced concrete on Cement stabilised
C8	Non-reinforced concrete on Natural gravel
C9	Non-reinforced concrete on Lime stabilised sub-base
C10	Non-reinforced concrete on Cement stabilised sub-base
C11	Emulsion seal on Lime stabilised
C12	Emulsion seal on Cement stabilised
C13	Emulsion seal on Emulsion stabilised
C14	Emulsion seal on Dry bound macadam sub-base
C15	Emulsion seal on Natural gravel with Amoured
C16	Two layers bitumen seal on Water bound macadam
C17	Sand seal on Concrete brick on Dry bound macadam
C18	Sand seal on Concrete brick on Natural gravel
C19	Burnt clay brick on Lime stabilised
C20	Burnt clay brick on Cement stabilised
C21	Emulsion sand seal on Burnt clay brick on Lime stabilised
C22	Emulsion sand seal on Burnt clay brick on Cement stabilised
C23	Mortar Dressed stone on Natural gravel sub-base
C24	Bitumen penetration macadam 6cm
C25	Water bound macadam
C26	Natural gravel surface/laterite

# RRST Cost Model

## Road Environment Codes

### Traffic and Axle loading

Ref	Equivalent standard axle	Classification of estimated traffic volume	Class of loading	Code	Number of vehicle passes during design period
1	6T	High traffic volume	A1	I	$> 15 \times 10^5$
2	6T	Medium traffic volume	A2	II	$5 - 15 \times 10^5$
3	6T	Low traffic volume	A3	III	$< 5 \times 10^5$
4	2.5T	High traffic volume	B1	I	$> 15 \times 10^5$
5	2.5T	Medium traffic volume	B2	II	$5 - 15 \times 10^5$
6	2.5T	Low traffic volume	B3	III	$< 5 \times 10^5$

Note: If vehicle passes during the design period will exceed  $5 \times 10^5$ , or heavy truck traffic is expected on the road (axle loads  $> 10t$ ), then:-  
gravel will probably not be a viable surfacing option, and road pavements will require specific engineering design.

# RRST Cost Model

## Further Research Discussion Issues

1. Arrangements for long term monitoring of RRST-I and RRST-II → performance & maintenance data
2. Development of routine maintenance Norms for some new pavement options in Vietnam. The existing Norms anyway need updating and expansion.
3. Vietnam Vehicle Operating Cost relationships to be researched to be used for the Transport Whole Life Cost analysis.