

Materials Resource Planning for Appropriate Road Construction

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Intech-TRL

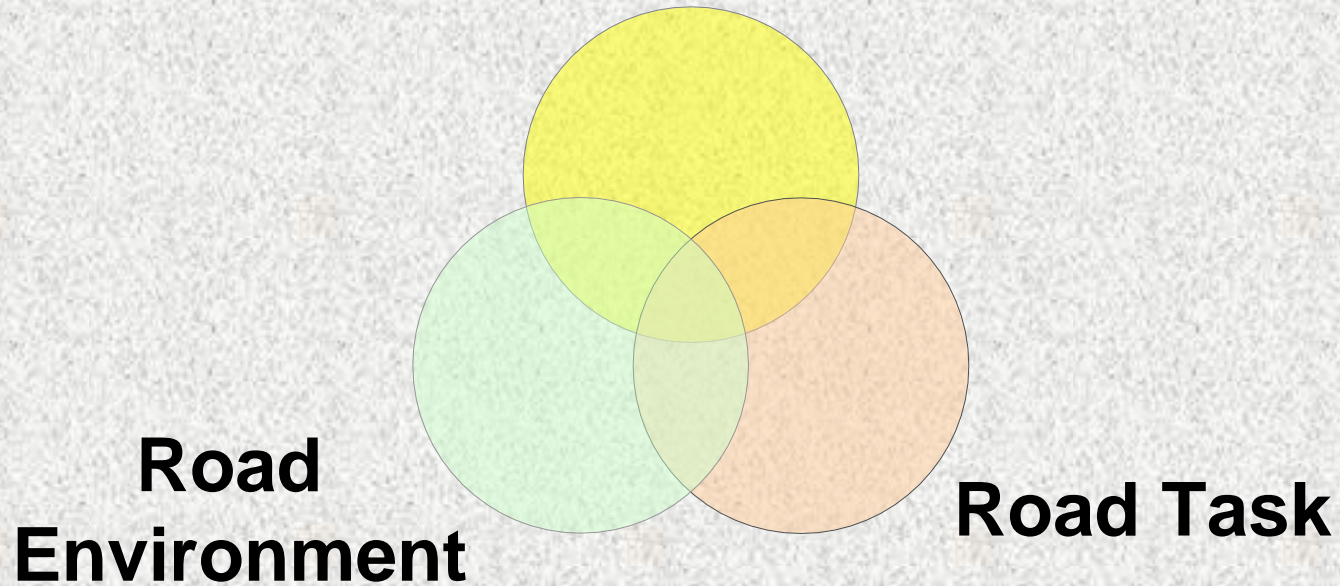
Sustainable Road Construction



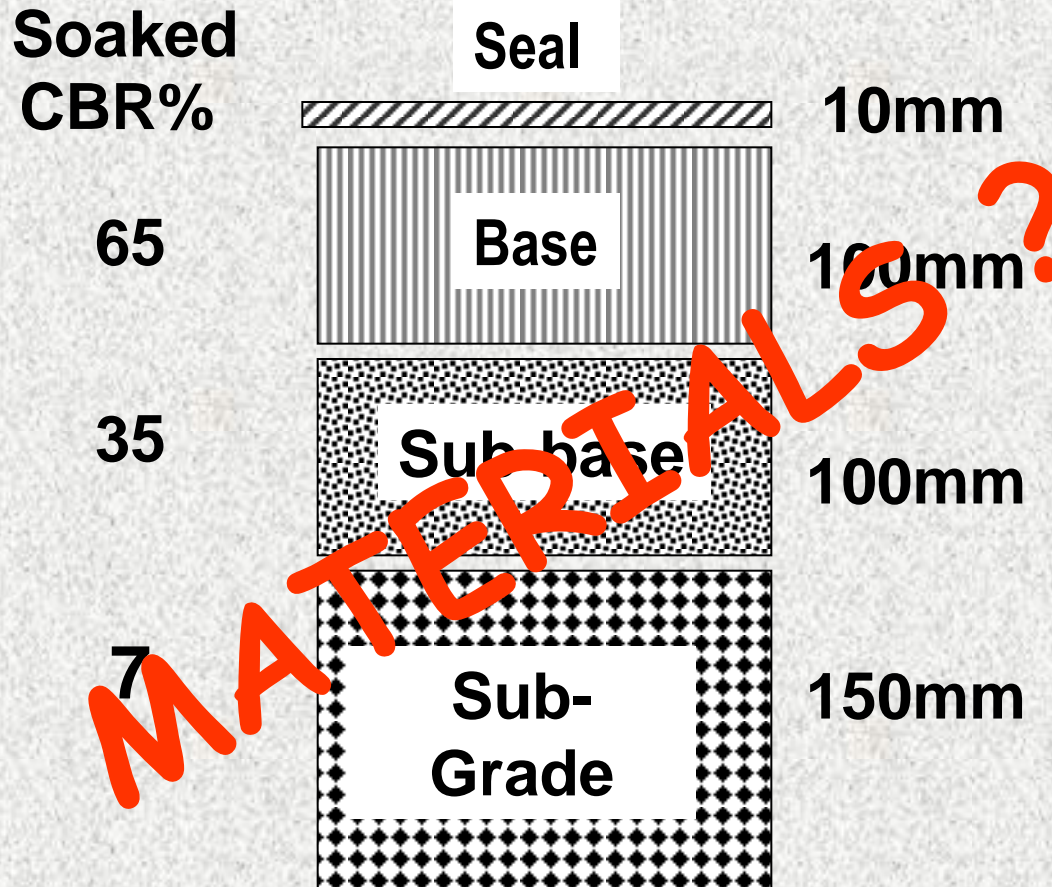
Match the available material to its road task and the local environment

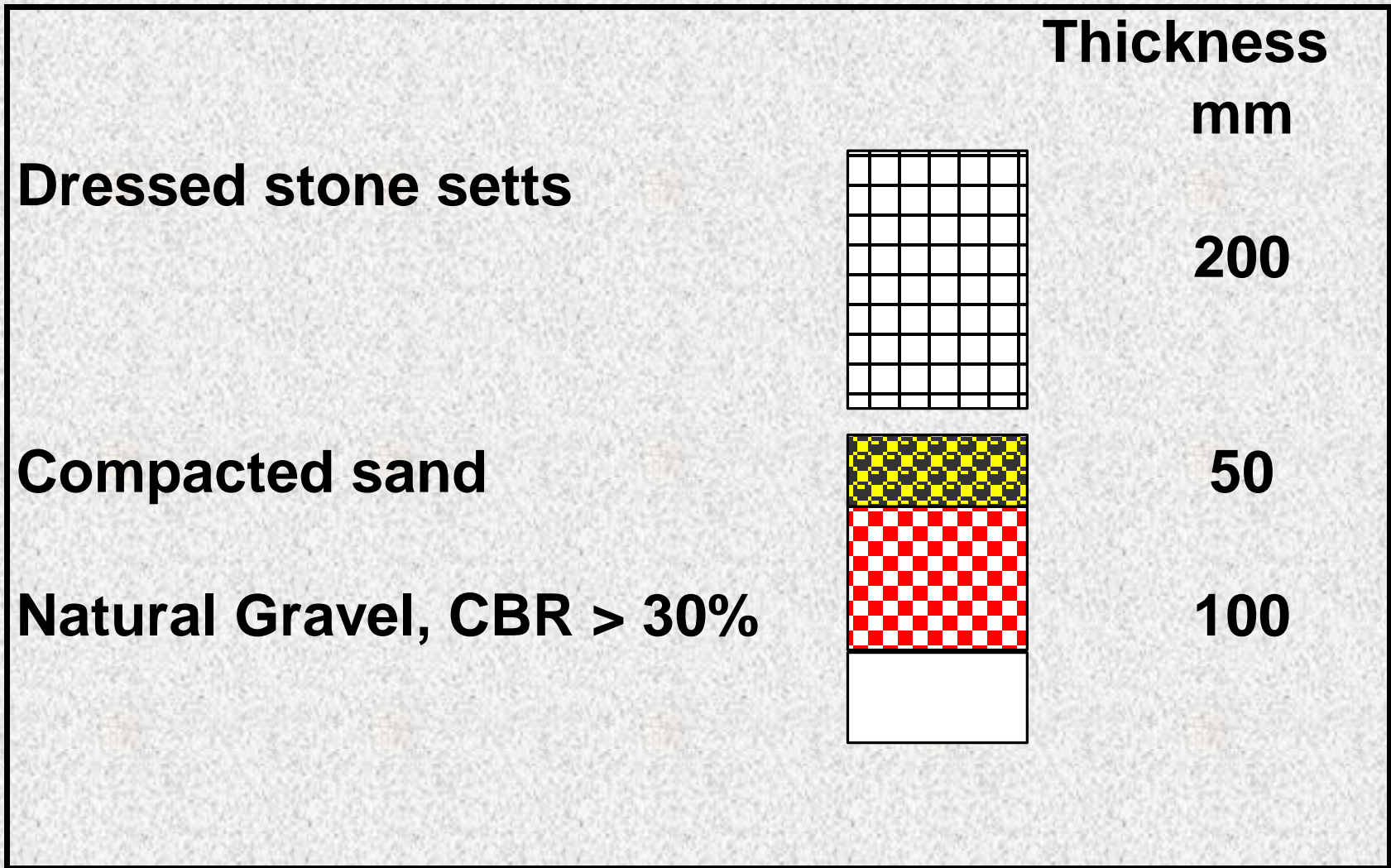


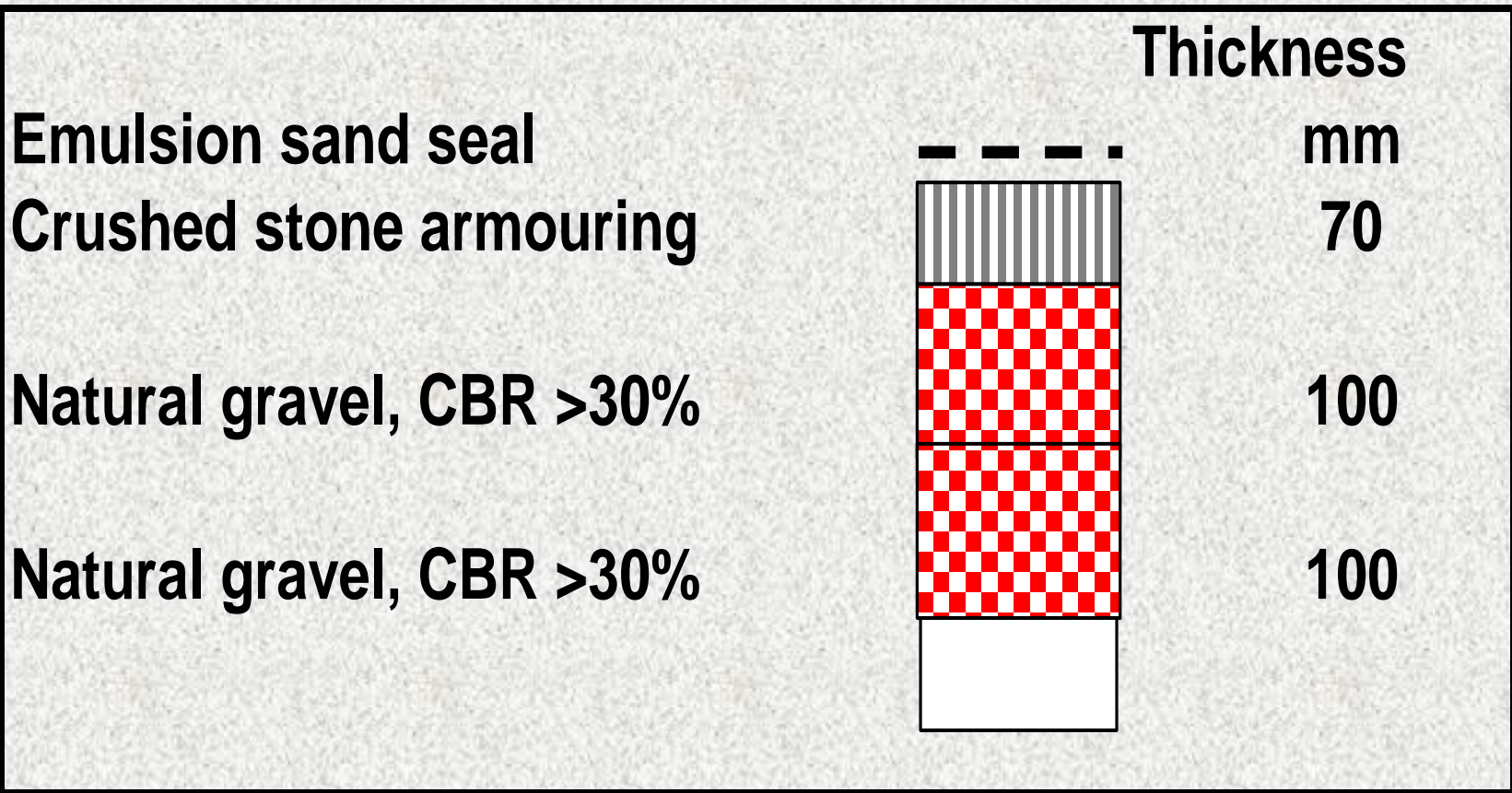
Available Materials

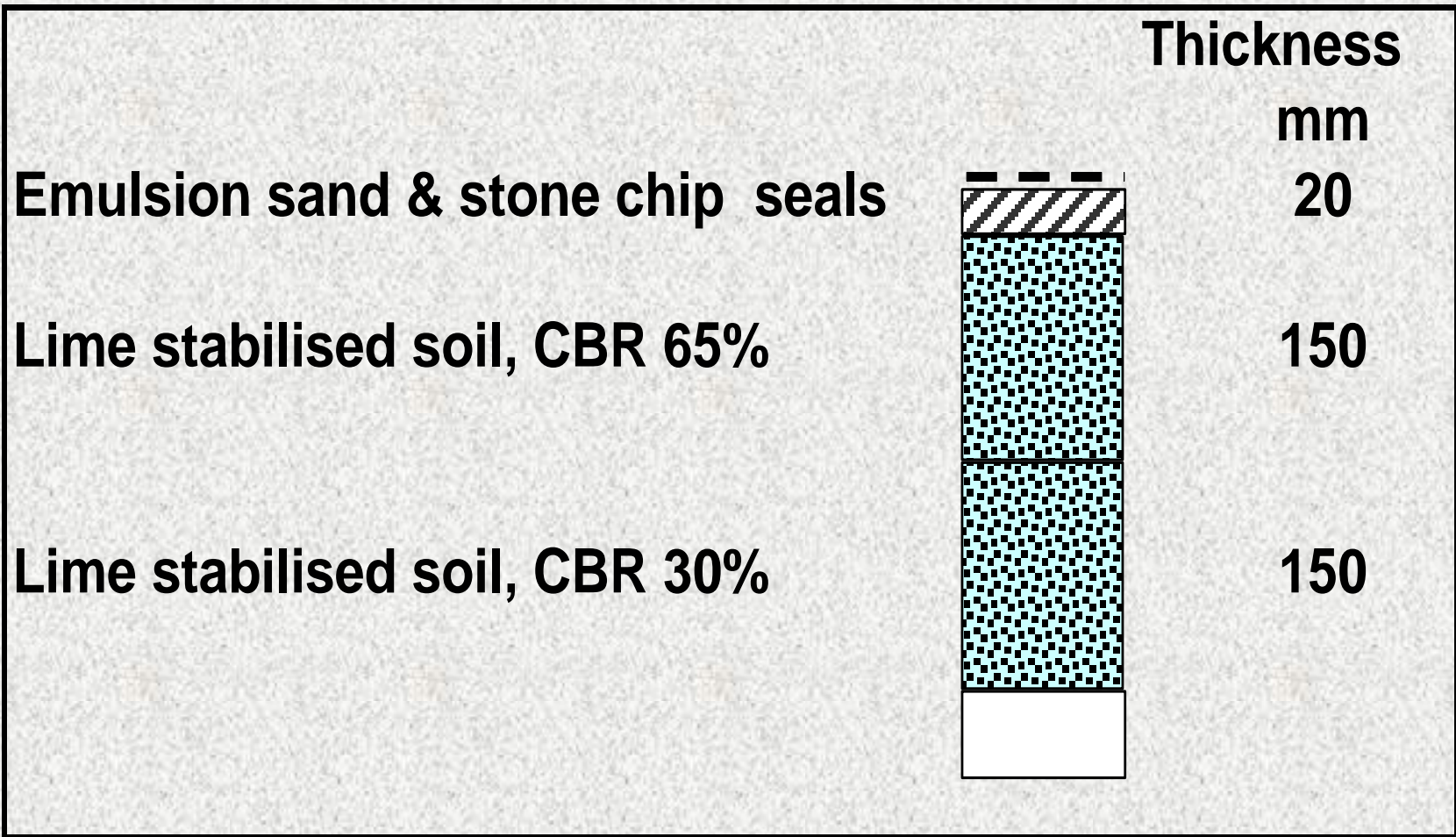


A Typical Low Volume Rural road







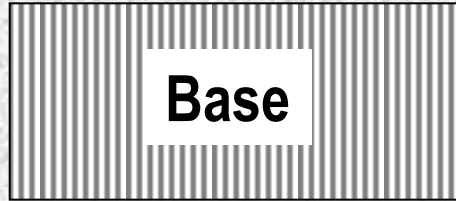


Seal



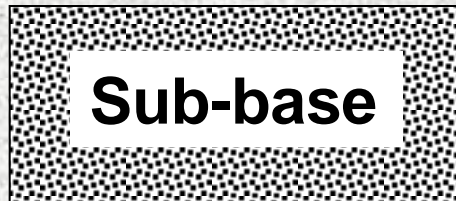
10mm

Base



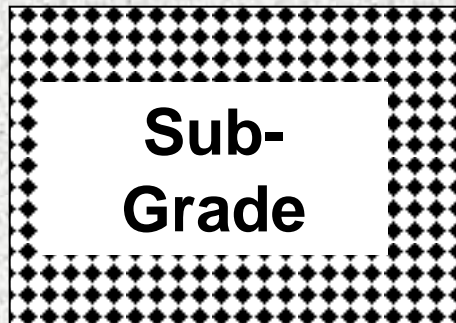
100mm

Sub-base



100mm

Sub-Grade



150mm

Graded crushed stone

Weathered rock gravel

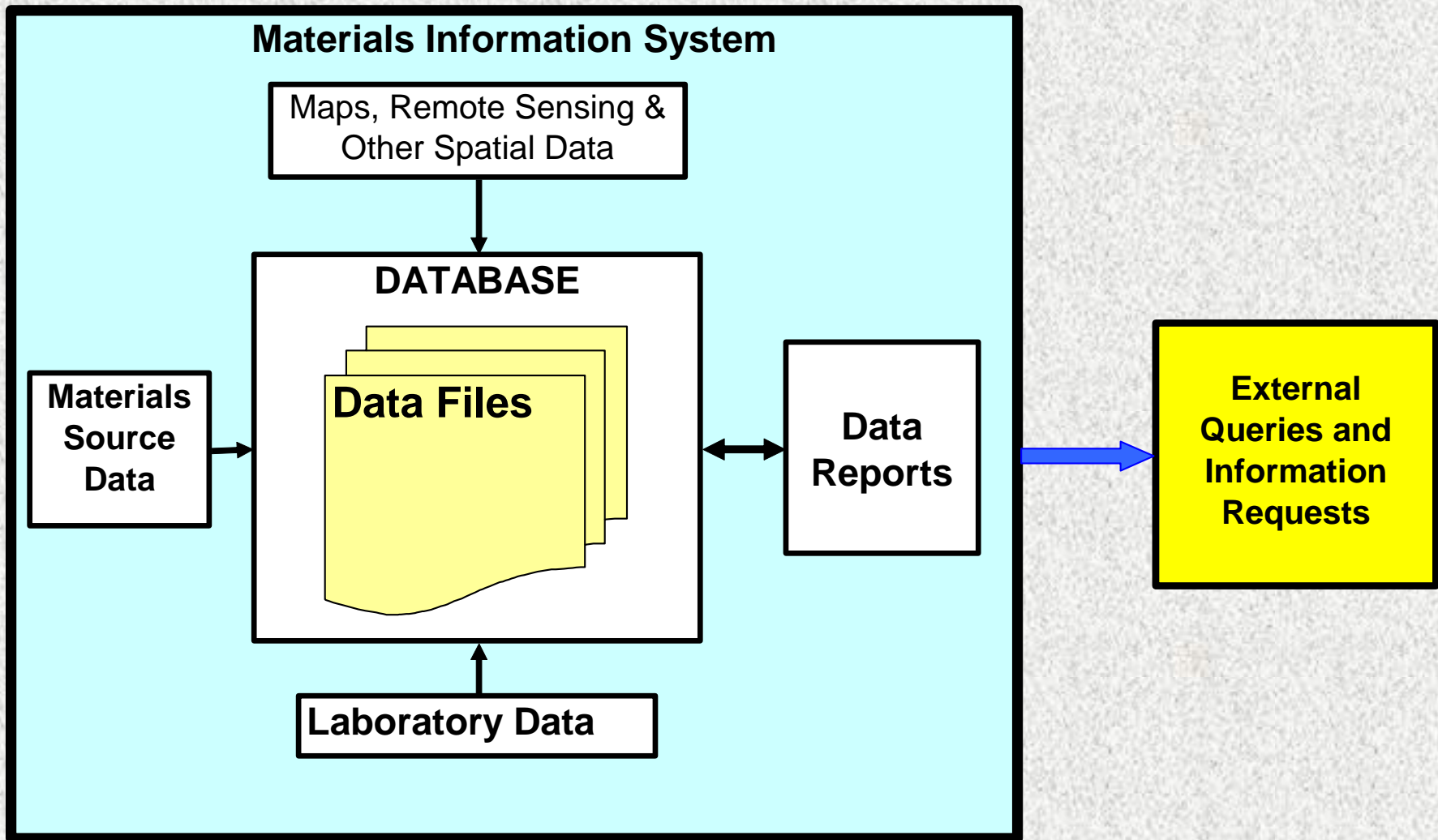


Knowledge-Based Decisions

- ❑ Material Types
- ❑ Material Locations
- ❑ Material Properties
- ❑ Haulage Costs
- ❑ Haulage Implications

MATERIALS PLANNING

MATERIALS RESOURCE INFORMATION SYSTEM



COMPUTER BASED MATERIALS INFORMATION SYSTEMS

- SIMPLE SPREADSHEETS
- SIMPLE DATABASES
- LINKED DATABASES
- COMPLEX INTEGRATED SYSTEM BASED ON GIS-AWARE SOFTWARE

Typical Queries

- ❑ **Quarries/Pits within a defined area**
- ❑ **Relative costs of material types**
- ❑ **Utilisation options for specific materials or quarries**
- ❑ **Potential resources for development**

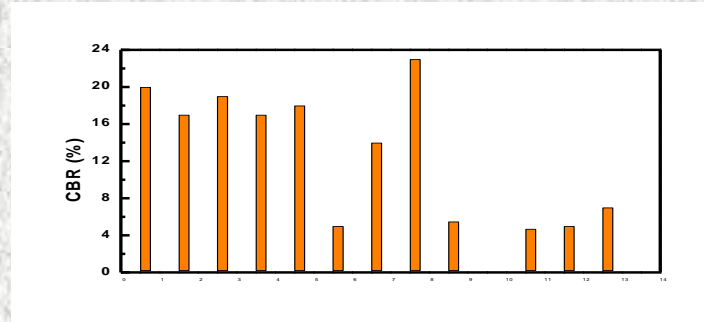
Reports

Establishment of a computerised materials inventory

- 1) **Materials inventories have been developed and established in Zimbabwe and Malawi in which data on the location and use of road building materials can be held centrally by computer and accessed by users. The computerised systems enable materials information to be recorded, organised, archived and retrieved.**
- 2) **The type, quality and volume of data available were different in each of the countries. Different development procedures were adopted in each case in consultation with potential users.**

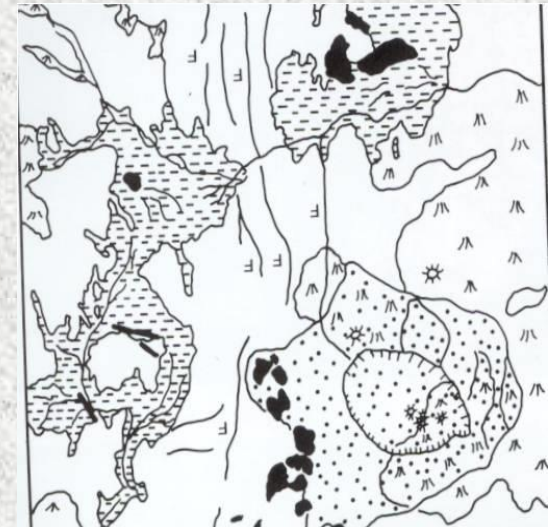
Updating and sustaining the database

- 5) **Although the basic structures of the materials inventories are in place, these inventories need to be continually updated, upgraded, and maintained. This requires the on-going provision of adequate financial resources.**
- 6) **Good laboratory management practices, including quality assurance procedures, were identified as an important prerequisite to setting up a materials inventory. This requires good laboratory management and staff training to ensure reliable data and sustainability of the database.**



Graphs

Maps



Tables

TT Lab No	Ký hiệu mẫu Sign. of Samples	Số lượng mẫu Add. of Samples	Phân tích thành phần h't - Analysis Test							
			Chỉ h't / Hàm lượng h't lát sùng							
			Sieve Size - D (mm) / Passing percentage - P (%)							
			50	37.5	25	19	9.5	4.75	2.0	0.425
79	QN 206-3	Sàng số 11 đục - km 1 + 500	100.0	81.7	76.2	71.8	59.4	47.6	30.4	10.5
80	QN 209-1	Quặng thén - Quặng ninh - km 0 + 400	100.0	100.0	99.3	97.4	92.4	70.5	44.0	6.8
81	QN 216-2	Càng hầu - Cèm phít Quặng ninh - km 0 + 500	100.0	100.0	86.1	73.4	65.8	61.5	57.2	13.3
82	QN 209-3	Quặng thén - Quặng ninh - km 1 + 500	100.0	82.8	72.5	63.4	52.4	35.5	23.0	5.1
83	QN 211-2	Sỏi va - Phóng thén	100.0	100.0	99.4	99.4	99.1	96.3	45.5	7.0
84	QN 213-3	Sàng số 11 đục - Sàng 1 n Bachi - Quặng ninh - km 1 + 460	100.0	100.0	96.1	95.1	92.3	89.4	84.9	21.3
85	QN 217-2	Sàng số 2 - D - ng huy Cèm phít - Quặng ninh - km 0 + 600	100.0	100.0	98.6	96.6	92.7	88.8	79.0	23.8
86	QN 214-1	Sàng số 11 đục - Sàng 1 n Bachi - Quặng ninh	100.0	100.0	100.0	99.4	97.4	93.6	87.0	19.3
87	QN 207-3	Sàng số 11 đục - km 5 + 750	100.0	94.7	88.8	54.2	46.2	40.7	35.6	10.3
88	QN 217-3	Sàng số 2 D - ng phông - Cèm phít - Quặng ninh - km 1 + 700	85.3	81.6	55.7	42.9	33.0	21.4	12.7	3.3



Climate

Geology/Soils

Material Character

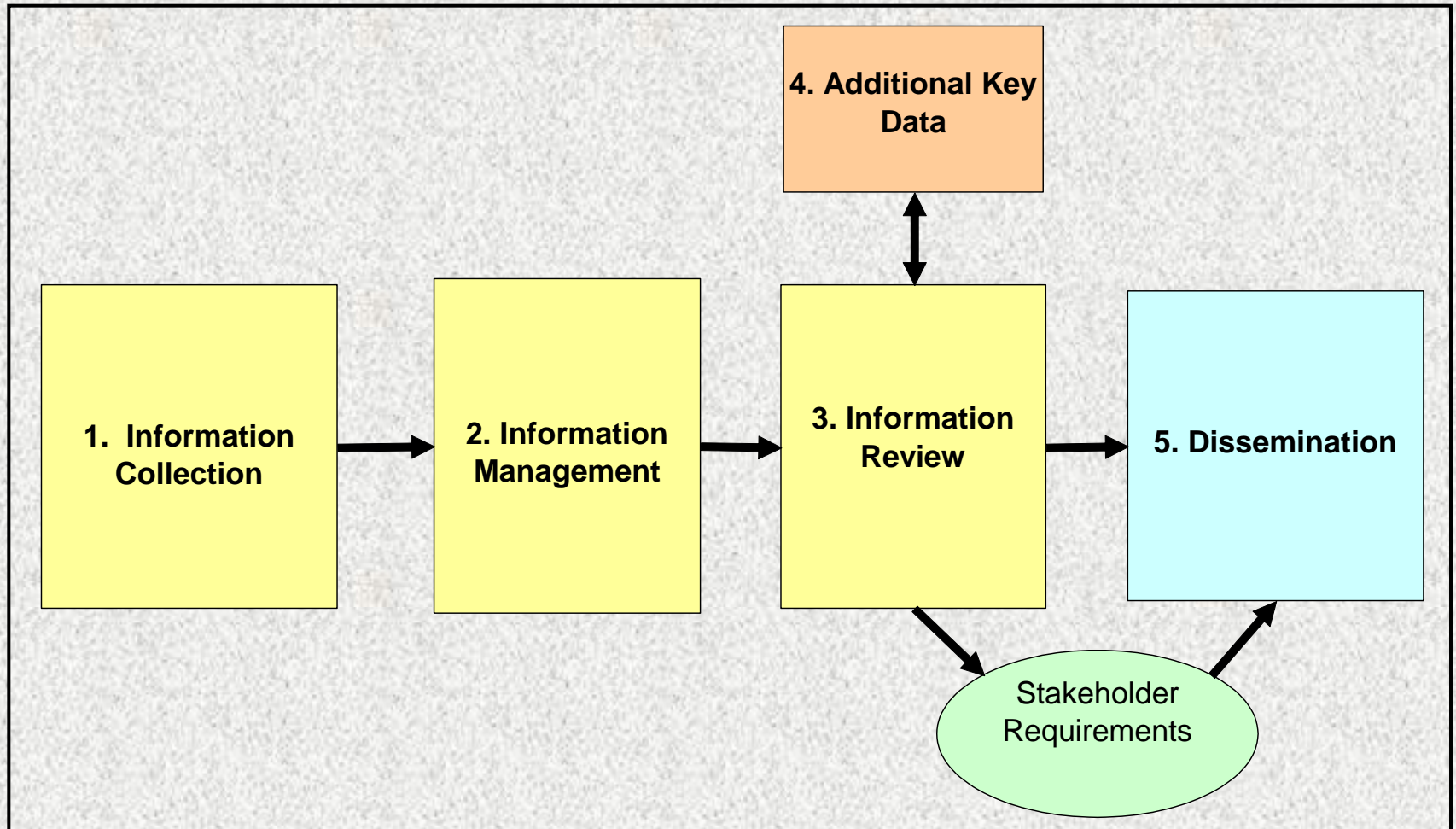
Source locations

Topographic Base Map

Basic Requirements

- ❑ **Defined need**
- ❑ **Clear objectives**
- ❑ **System Host**
- ❑ **Design framework – existing data, maps, systems etc**
- ❑ **Staff – Field, Lab, Computer**
- ❑ **Funding - ongoing**

RMIS Modules



A RMIS Needs to be Sustainable

- ❑ **FLEXIBLE TO CHANGES IN USER NEEDS, HARDWARE OR SOFTWARE**
- ❑ **RECOGNISED AS PART OF A PLANNING OR THE MATERIALS MANAGEMENT STRUCTURE**
- ❑ **SECURED FUNDING**

Stakeholders	Objectives
Local Communities	Better planning of local extractions, more effective safeguards on environmental damage, advance warning on potential overloading and deterioration of local roads
Ministries	Data available on the location, properties and costs of materials; more accurate cost planning; more effective use of diminishing resources; empowerment tool for overload control
Local Research Institutions	Transfer of technology on the procedures for materials location and practical data management. Institutional strengthening
DFID/TKP/IFG	Development of methodologies for international adaptation.
Donors	Better information for the assessment of road schemes and more accurate cost estimates.

Information Requirements

- ❑ **ACCURATE**
- ❑ **EASILY RECOGNISED FORMAT**
- ❑ **ACCESSIBLE**

ICMIS: Indonesian Construction Materials Information System

Phase		Description	Time
I	Background Research	Review of Indonesian requirements. Identification of key data sets	3 months
II	System Setup and Trials	Design of database systems. Comprehensive trials undertaken in one province	9 months
III	Nation-wide Set-up	National input of available provincial data and refinement of database design.	20 months
IV	Mainstream ICMIS	Mainstreaming through training programmes and workshops. Data updates commenced by provinces.	10 months

- A funded road development programme
- The requirement within the Indonesian MoW
- An existing road research institute
- Terrain evaluation maps
- Geological map coverage
- Total topographic map coverage of Indonesia
- Materials data within provincial administrations
- No existing materials information systems

Key ICMIS Data Files

- ❑ **Location**
- ❑ **Source Definition**
- ❑ **Material Description**
- ❑ **Product Description/Costs**
- ❑ **Laboratory Results**

ICMIS: Typical Fields

	Field	Section	Description
	Source File : RMI-Q0		
RMI_Q0	ID1_SVY	Identification key	Survey code
RMI_Q0	ID1_PRV	Identification key	Province code
RMI_Q0	ID1_DST	Identification key	District code
RMI_Q0	ID1_SRC	Identification key	Source code
RMI_Q0	LO1_SUBDST	Location	Sub district code
RMI_Q0	LO2_DESA	Location	Village
RMI_Q0	LO3_KAMPNG	Location	Kampong
RMI_Q0	LO4_SRCNAM	Location	Source name
RMI_Q0	LO5_RIVER	Location	River
RMI_Q0	LO6_ROADFR	Location	Road from
RMI_Q0	LO7_ROADTO	Location	Road to

ID1_SRC	Identification key	Source code
ID2_M_P_N	Identification key	Material number
ID2_M_CODE	Identification key	Material kode
MI1_M_TYPE	Material Information	Material type
MI2_PETNME	Material Information	Petrological name
MI3_MPECNT	Material Information	Percentage of material
MI4_N_SMPS	Material Information	Number of samples taken
MU1_SUFDRS	Material Usage	Surface dressing
MU2_ASPAG	Material Usage	Asphalt aggregate
MU3_BASE	Material Usage	Base
MU4_SUBBASE	Material Usage	Sub-base
MU5_SUBGDE	Material Usage	Sub-grade
MU6_FILL	Material Usage	Selected fill

PD1_PTYPE	Product type
PD2_SZMAX	Maximum size
PD3_SZMIN	Minimum size
PD4_VPD2	Variability size max
PD6_SHAPE	Product shape
PD7_VPD6	Variability product shape
PD8_ANGTTY	Angularity
PD9_VPD8	Variability angularity
PD10_TXTUR	Surface texture
PD11_VPD10	Variability surface texture
PP1_STNGTH	Particle strength
PP2_VPP1	Variability particle strength
PP3_DENSTY	Particle density
PP4_VPP3	Variability particle density
PP5_POROST	Particle porosity
PP6_VPP5	Variability particle porosity
PR1_PDRATE	Production rate
PR2_PDCOST	Production cost

ICMIS Applications

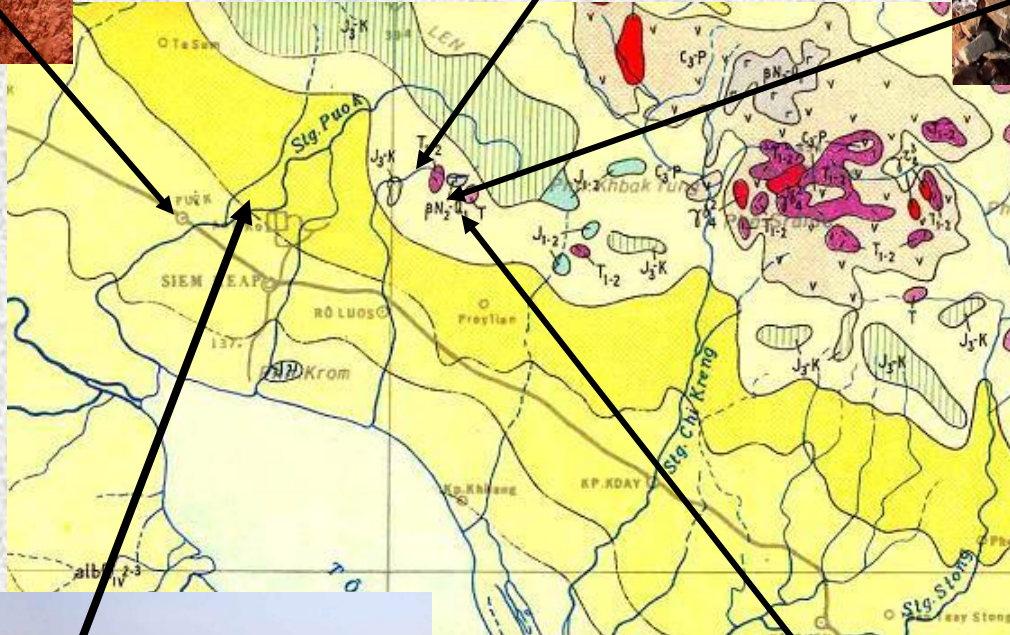
- Locating materials sources for national and provincial road projects
- Costing of materials in national, provincial and district road programmes
- Land use planning
- Starting point for road materials research

A Cambodian Road Materials Information System (CRMIS)

- ❑ Increase the capacity for Road-related departments to more cost-effectively plan and implement road programmes
- ❑ The establish a sustainable capacity for identifying natural construction materials
- ❑ Promote utilisation of locally available materials within appropriately road designs
- ❑ Development of material resources in a planned manner least likely to impinge upon the natural environment.

CRMIS: Starting Points

- Geological mapping at 1: 100 000 scale
- Existing topographic mapping – some digitised
- Land-use mapping
- Soil maps
- The IRAP GIS system in some provinces
- Recent research on road materials and paving options
- Research reports on geological materials



CRMIS – Possible Steps

1. Background research on data availability and type
2. Implementation in a trial area (or province)
3. Review of effectiveness of trial MIS
4. Modifications to trial
5. Full scale CRMIS establishment.

CRMIS Set-Up Requirements

- ❑ **Defined need**
- ❑ **Clear objectives**
- ❑ **System Host – Ministries**
- ❑ **Design framework – existing data, maps, GIS**
- ❑ **Staff**
- ❑ **Funding**