Road Pavement Maintenance and Rehabilitation

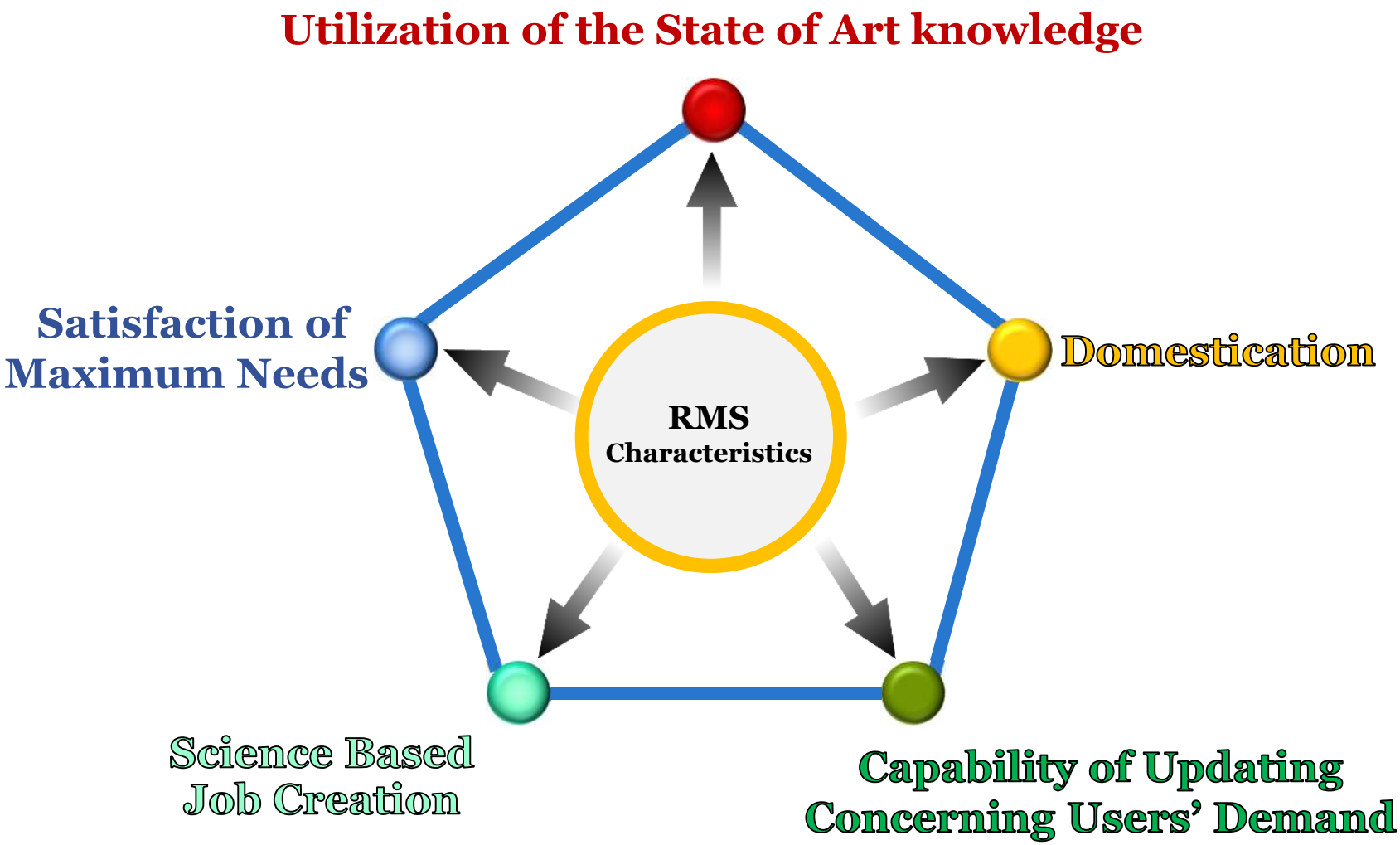
Genral Contractor

Road Management System

Definition:

RMS is a tool for assisting the decision making on the basis of a logic procedure in different levels of management and engineering.

Road Management System (RMS) Characteristics



Design, Implementation and Development of Road Management System

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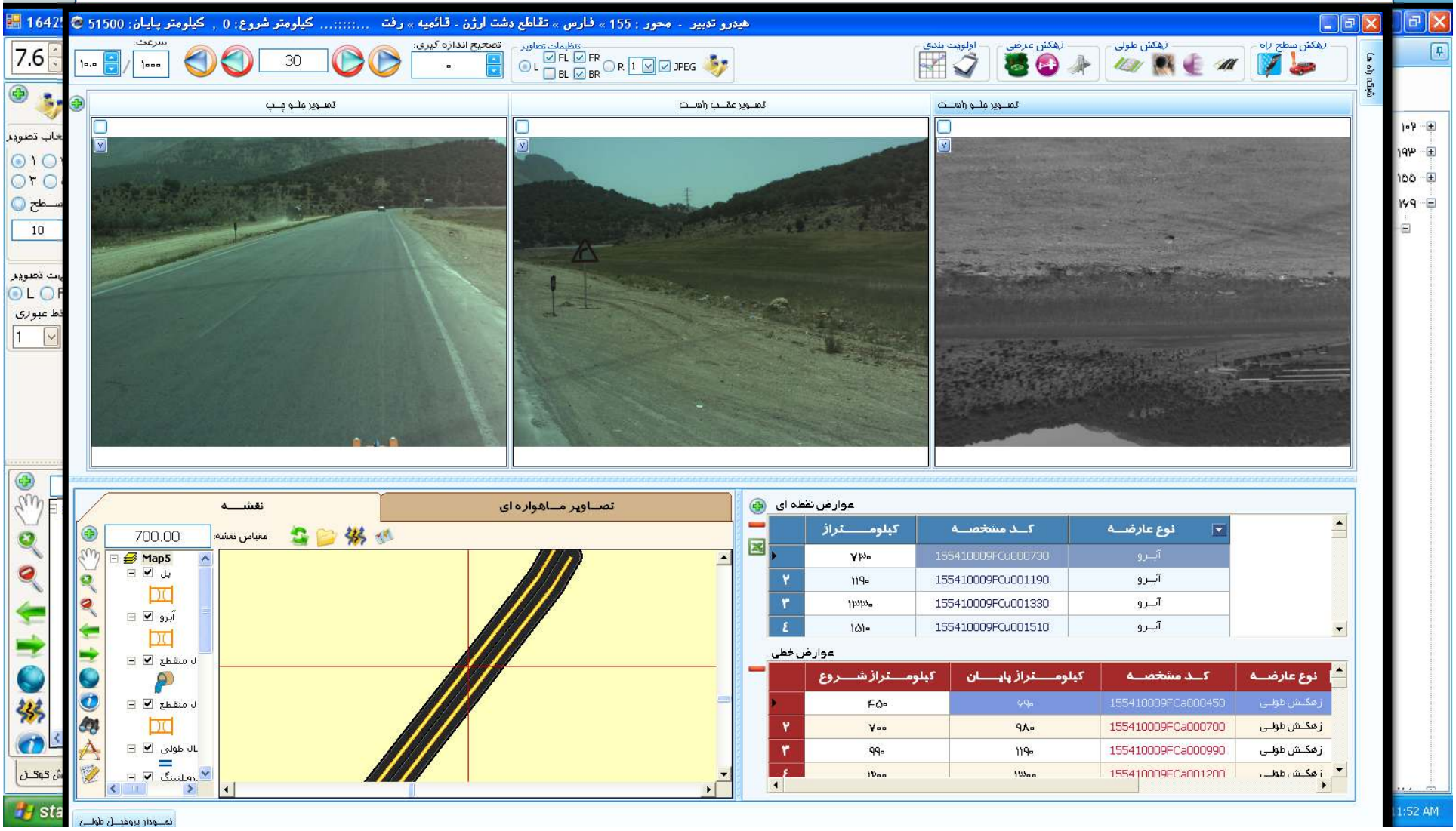
Data Analysis and Process



Implementation Procedure of Pavement Management System

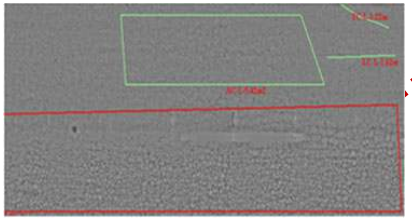
Climatic Condition Data

Traffic Data

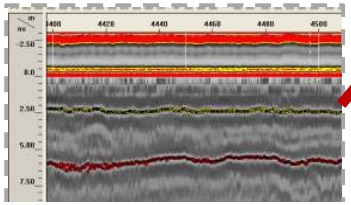
Pavement Inventory

Pavement Roughness Data

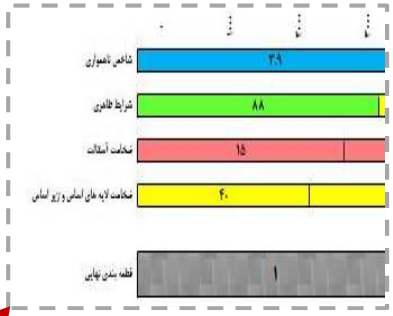
Pavement Visual Distresses



Pavement Layers Thicknesses

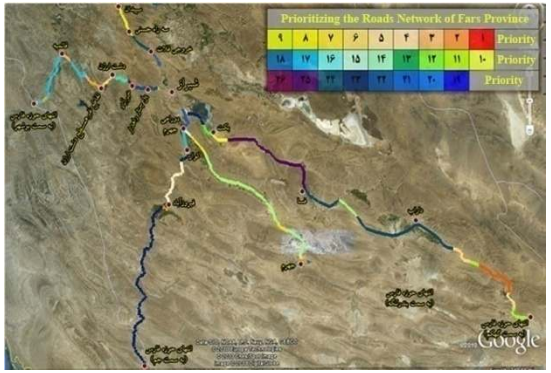


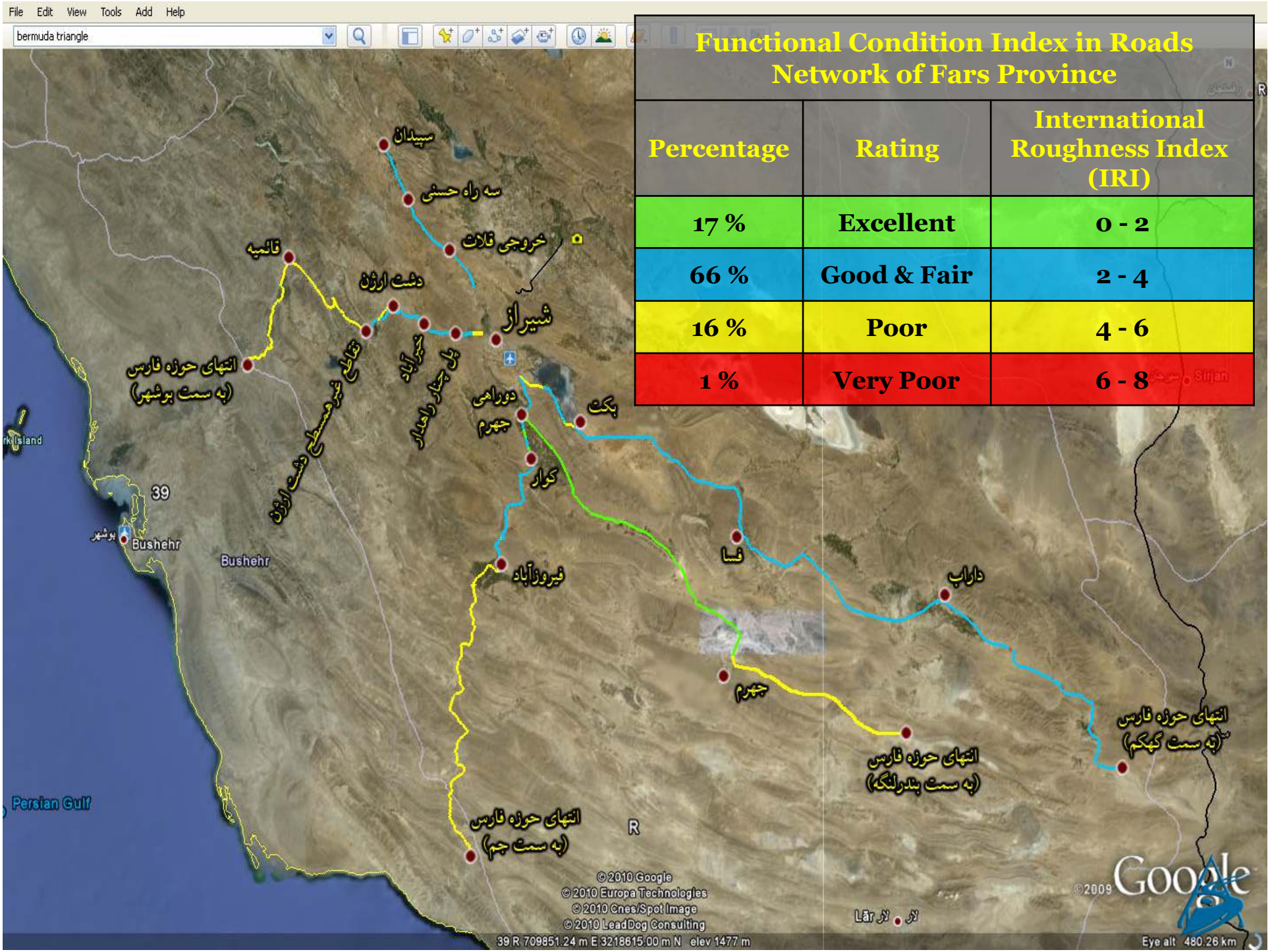
Pavement Sectioning



Allocation of M&R Strategies and Cost Estimation

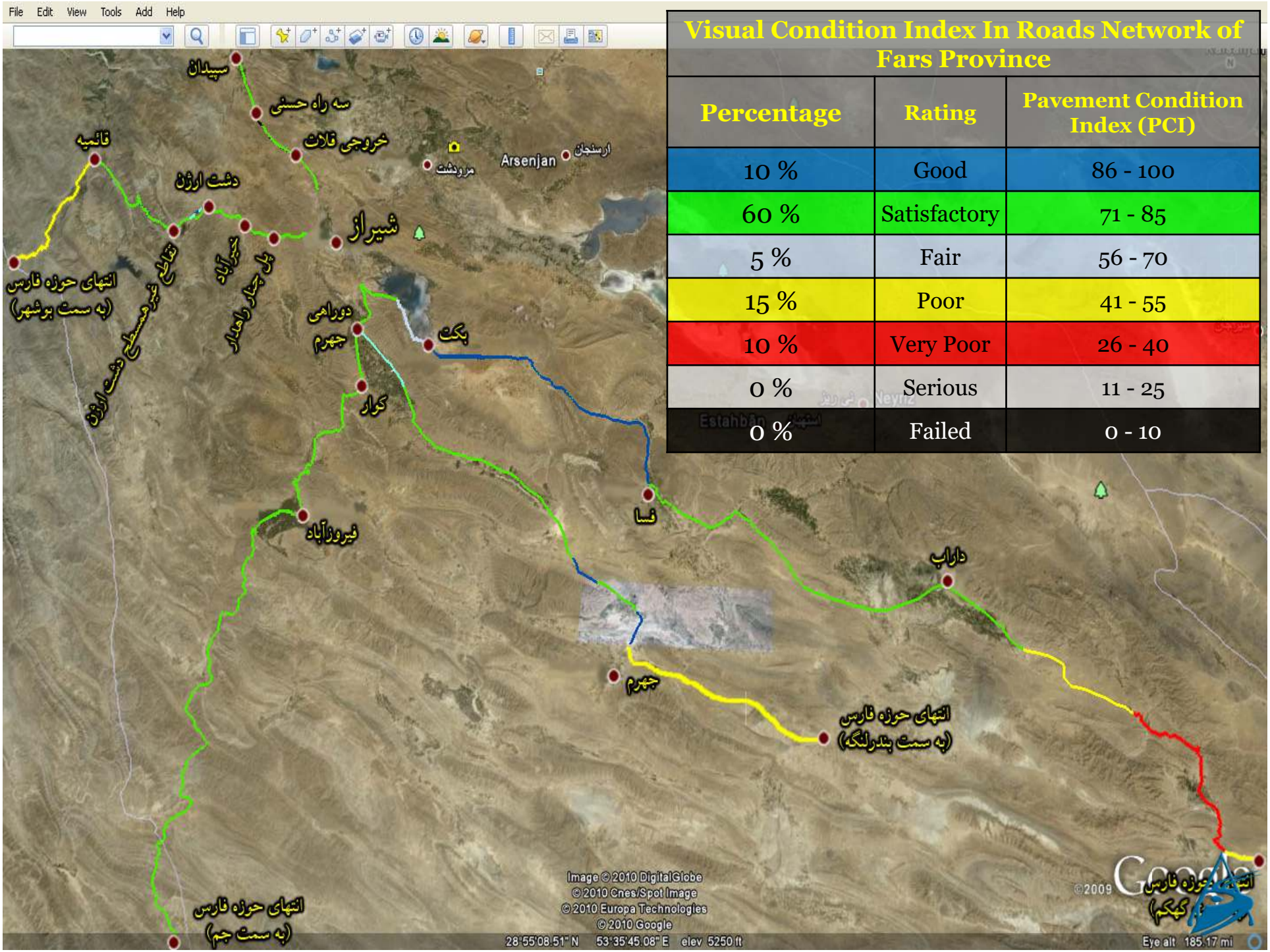
Prioritization of Road Network





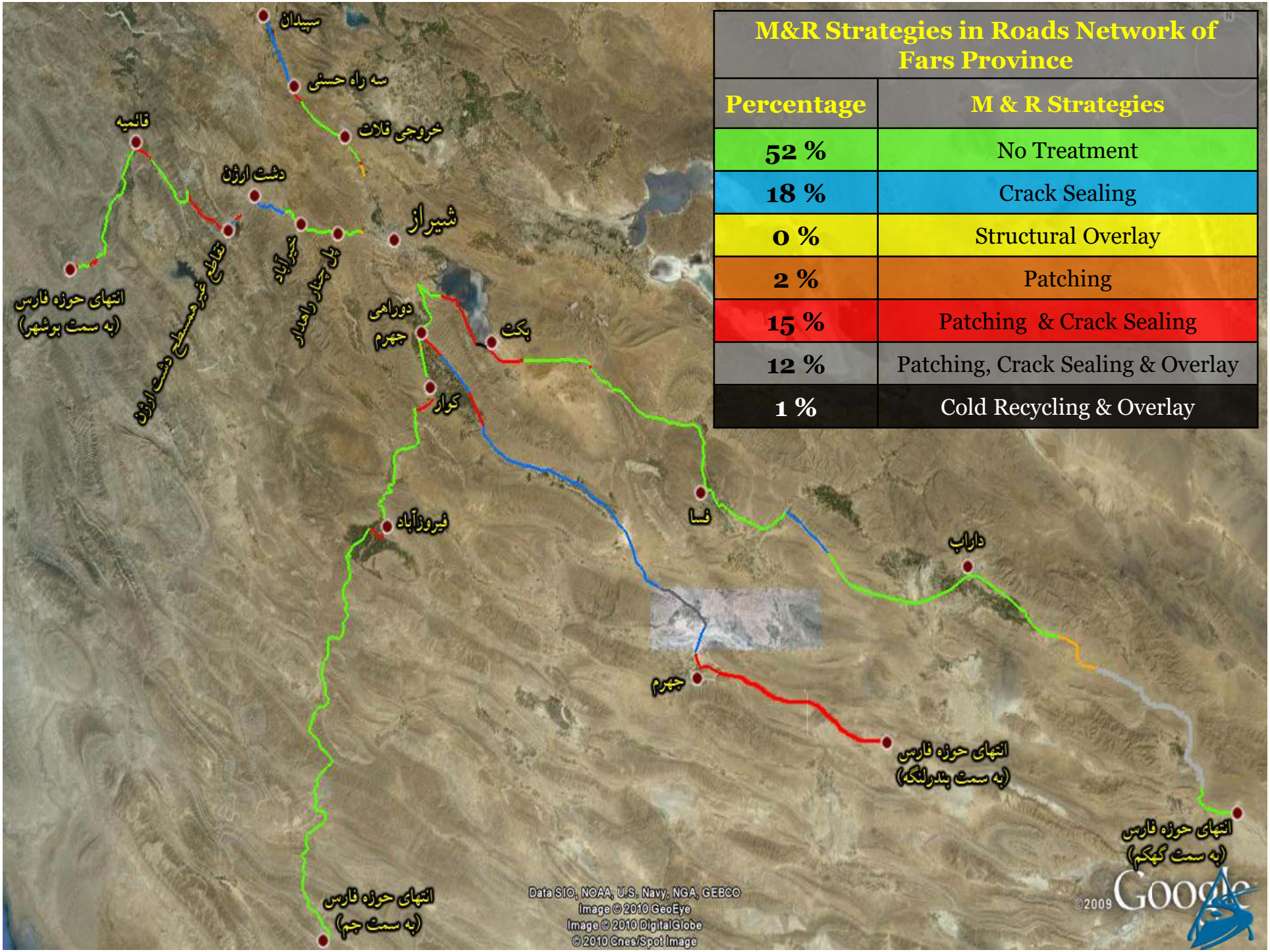
Functional Condition Index in Roads Network of Fars Province

Percentage	Rating	International Roughness Index (IRI)
17 %	Excellent	0 - 2
66 %	Good & Fair	2 - 4
16 %	Poor	4 - 6
1 %	Very Poor	6 - 8

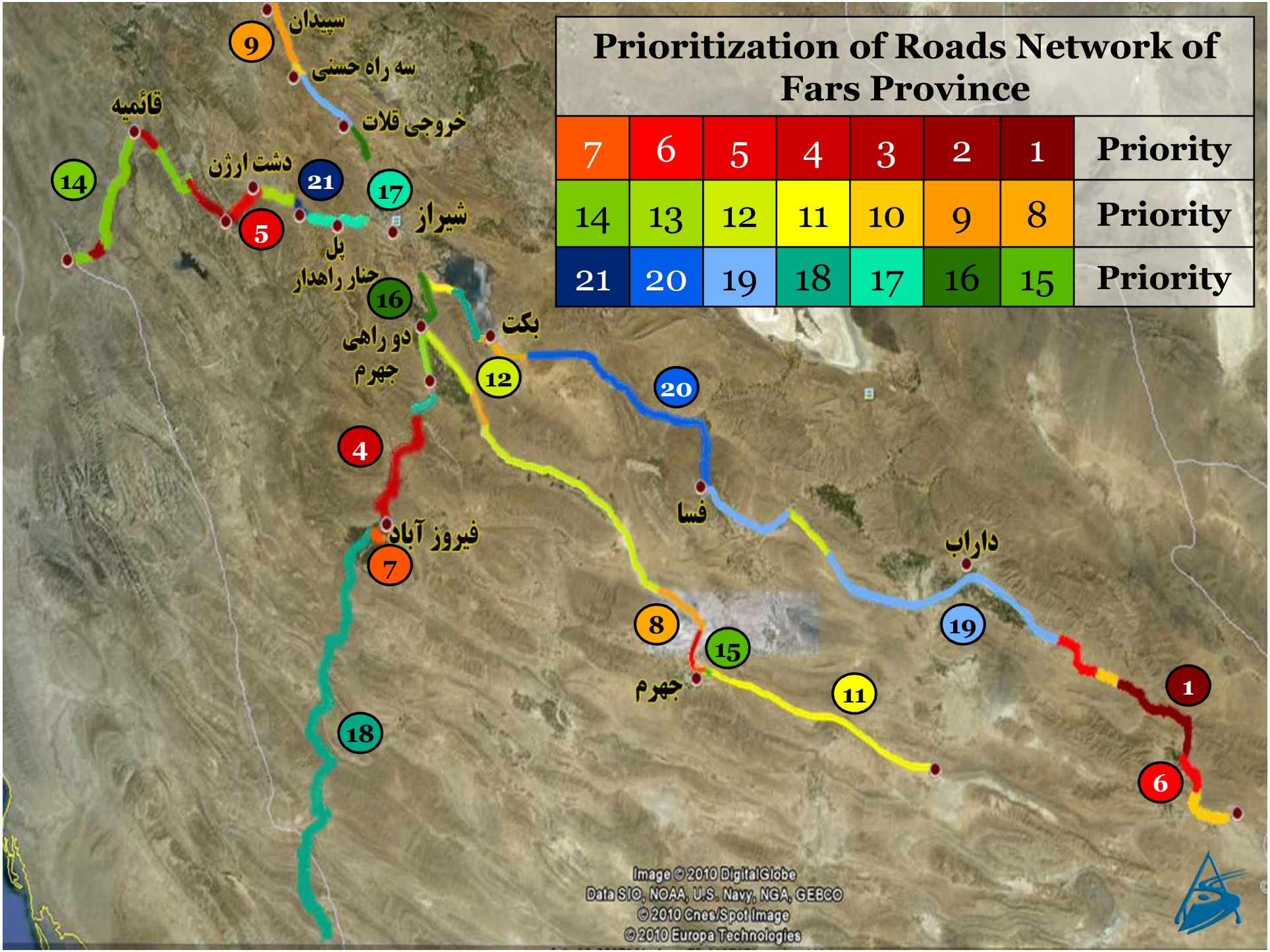


Visual Condition Index In Roads Network of Fars Province

Percentage	Rating	Pavement Condition Index (PCI)
10 %	Good	86 - 100
60 %	Satisfactory	71 - 85
5 %	Fair	56 - 70
15 %	Poor	41 - 55
10 %	Very Poor	26 - 40
0 %	Serious	11 - 25
0 %	Failed	0 - 10



M&R Strategies in Roads Network of Fars Province	
Percentage	**M & R Strategies**
52 %	No Treatment
18 %	Crack Sealing
0 %	Structural Overlay
2 %	Patching
15 %	Patching & Crack Sealing
12 %	Patching, Crack Sealing & Overlay
1 %	Cold Recycling & Overlay


Prioritization of Roads Network of Fars Province
7 6 5 4 3 2 1 Priority
14 13 12 11 10 9 8 Priority
21 20 19 18 17 16 15 Priority
سپیدان
سه راه حسنی
خروجی قلات
قائمیه
دشت ارژن
شیراز
پل
حنار راهدار
بکت
دو راهی
جهرم
فسا
داراب
فیروز آباد
جهرم
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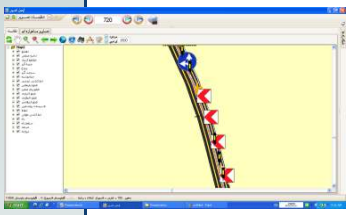
Implementation Procedure of Safety Management System

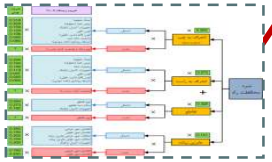
Mechanistic Surveying of Road safety

Collection of Current Condition Data



Determination and Placement of Needed Signs

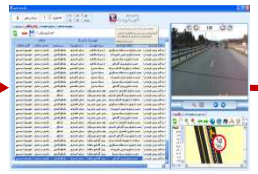
First Sectioning



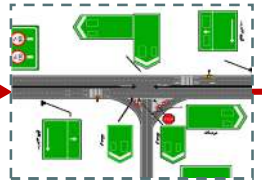
Accidents Analysis

Analysis and Final Sectioning

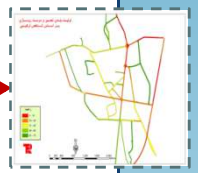
Presenting the Short and Long Term Solutions



Designing the Corrective Plans and Cost Estimation



Prioritization



Prioritization

Distribution of Road Safety Management System Budget

The Used Indexes to Prioritize The Hazardous Sections of Fars Province Roads Network

Group	Point	Index	Unit	Range					Reference
Hazards	45	Safety Prioritization Score (SPS)	-	64 < SPS < 100 45	36 < SPS <64 35	16 < SPS < 36 25	4 < SPS < 16 15	0 < SPS < 4 10	
Traffic Condition	10	Volume to Capacity Ratio (V/C)	-	./6 < 10	./4 < < ./6 8	./25 < < ./4 6	< ./25 4	< ./25 2	Code 161
	5	Annual Average Daily Traffic (AADT)	vehicle	$5*10^4$<	10^4 < X < $5*10^4$	10^3 < X < 10^4	<10^3	<10^3	Code 234
				5	4	3	1	1	
	10	Road Type	-	Freeway	Highway	Main Road	Secondary Road		Code 161
				10	8	6	4		
Climatic Condition	5	Climatic Condition	Average of Temperature and Precipitation	Cold 5	Hot 3	Mild 1			
Economic & political Condition	5	Economic, Social and Political Importance	-	Special	Ordinary				
				5	0				
	10	Cost of Making Safe	10^6 IRR	< 150 10	150 < X < 700 6	700 > 2			
Road Side Usage	10	Pedestrain Daily Traffic	person	High	Medium	Low			
				10	6	3			
Total	100								

Prioritization

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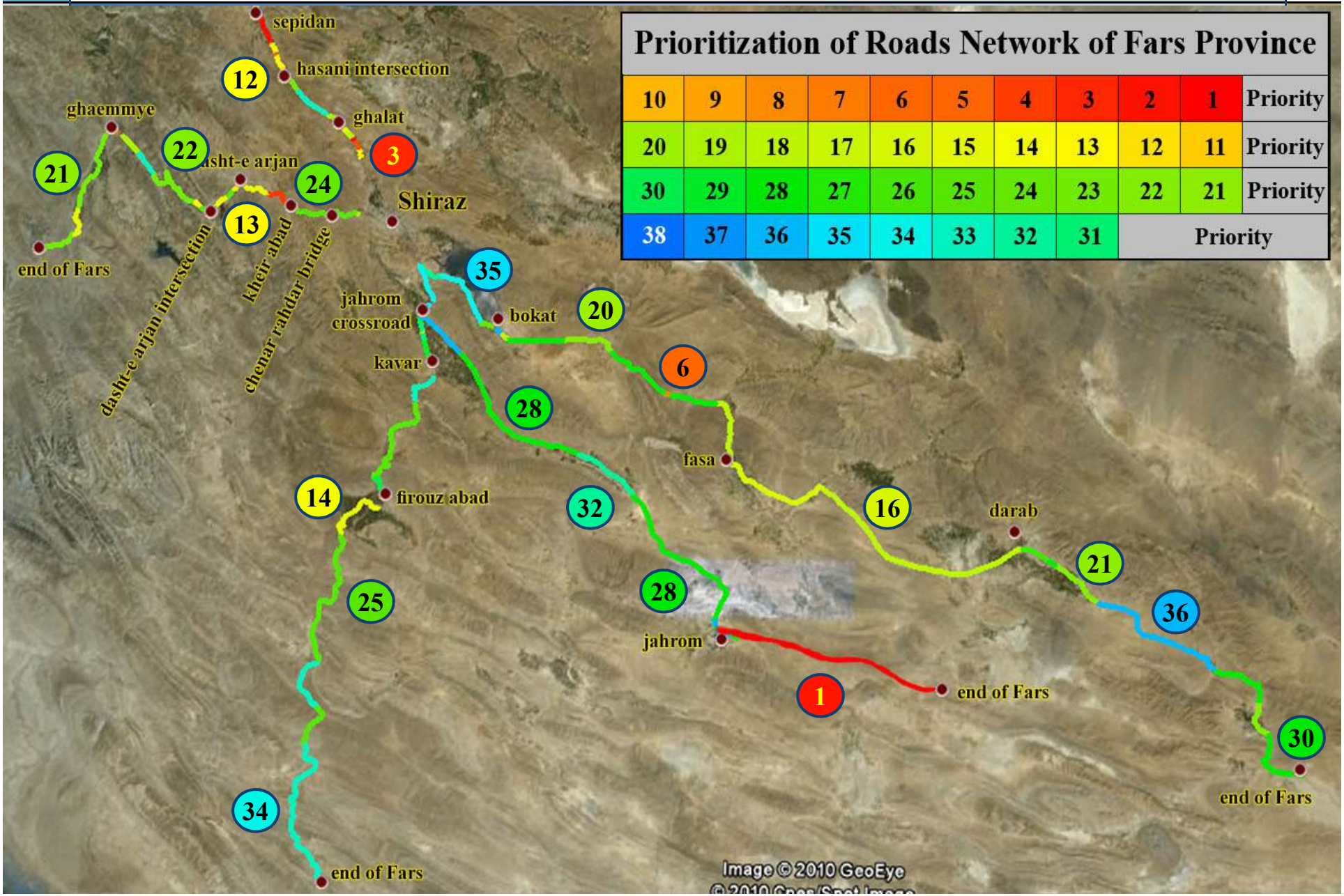
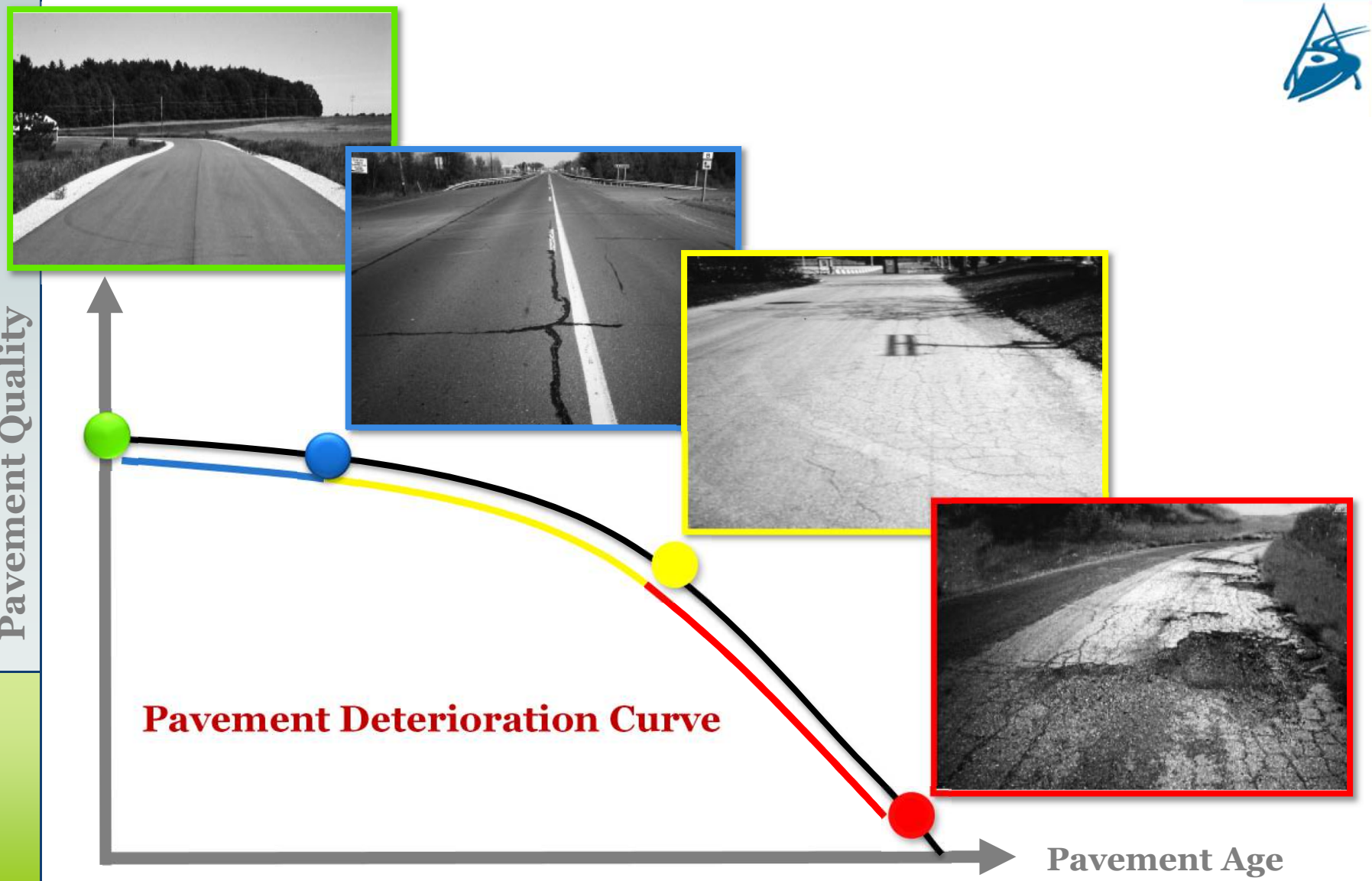


Pavement Deterioration with Time Passing
(Loading and Climatic Condition)

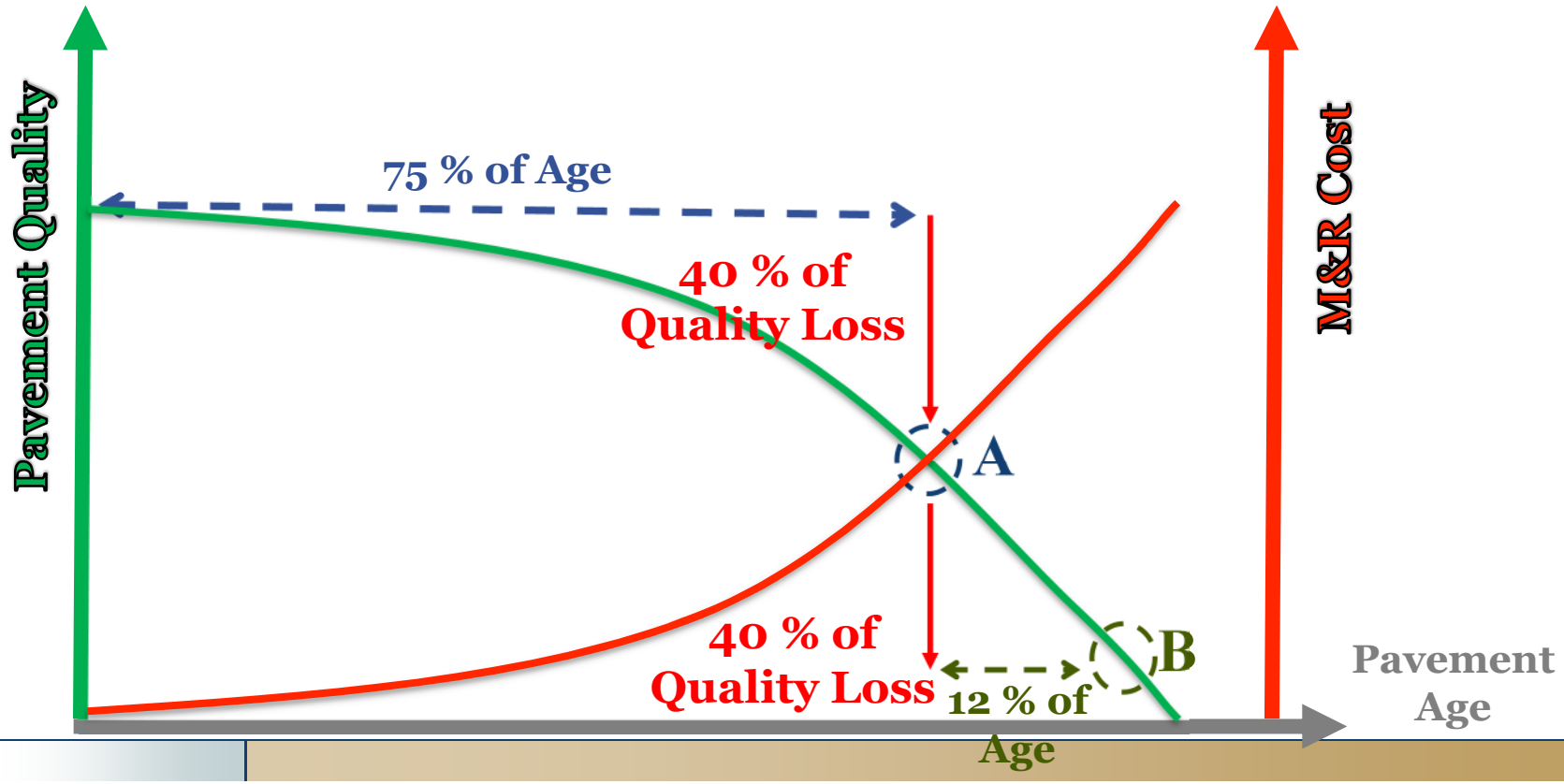


The Necessity of Determining the Optimum Time for Pavement Maintenance and Repair (M&R)

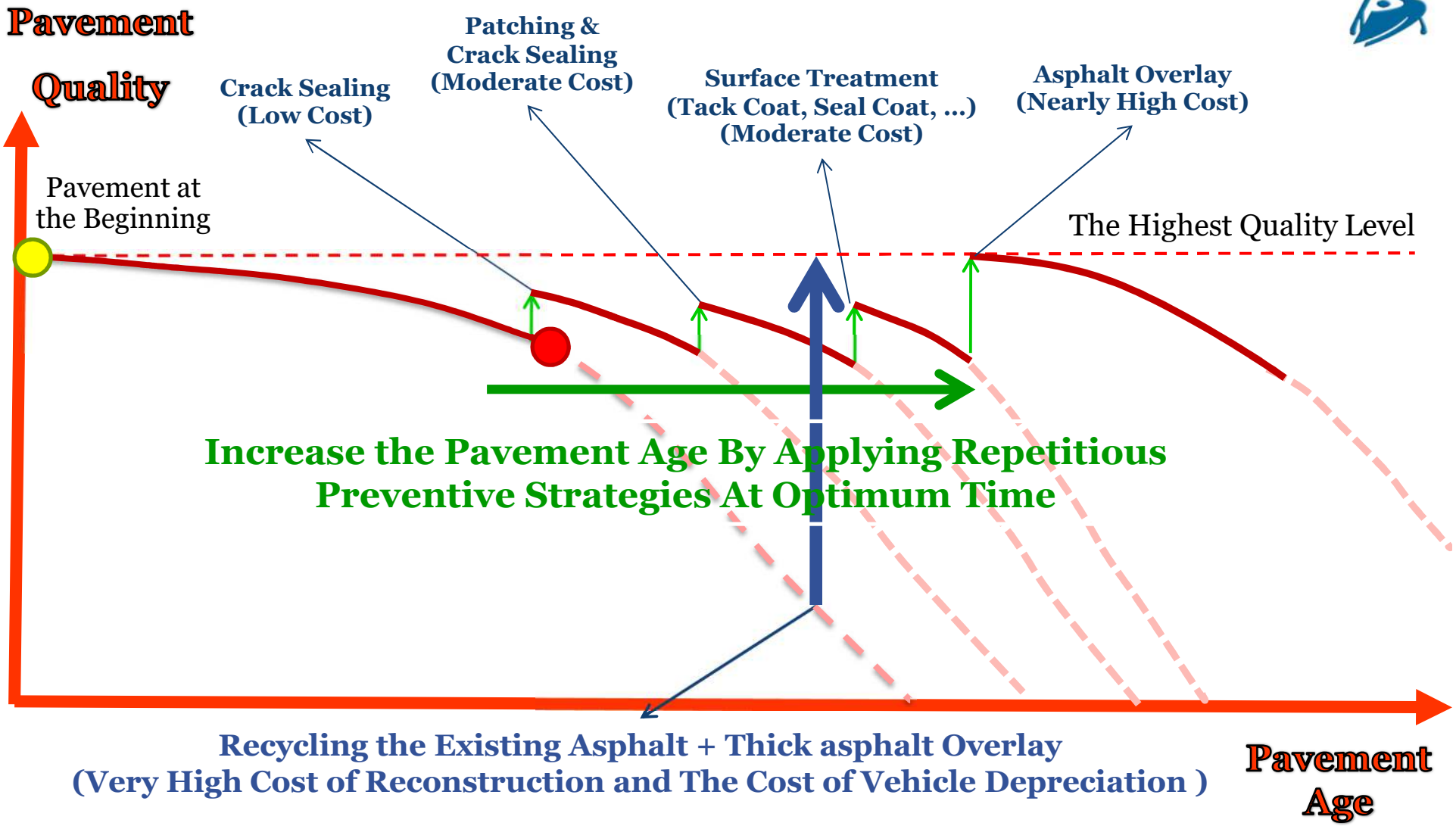
The severity of pavement quality loss will increase by the factor of 6 after point A.

At Point A → M & R Cost = 1 Unit

At Point B → M & R Cost = 4 Unit



The Influence of Preventive Strategies (Efficient with Low Cost) on Pavement Age Improvement



Road deterioration

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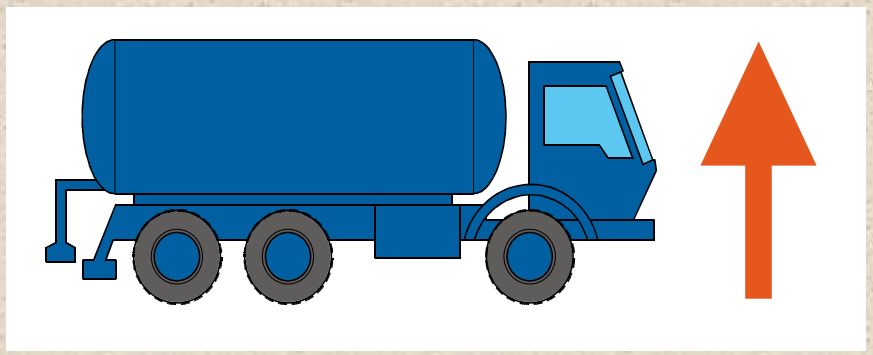
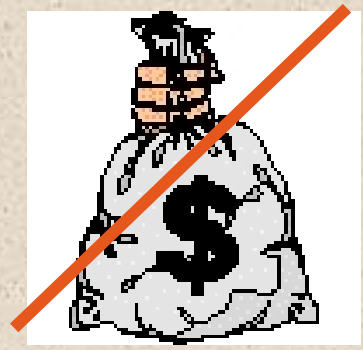


Rising Traffic

+



Less money available per km of road

=

Deterioration of roads increasing

Higher axle loads = increasing damage = less money available per km

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- **Pavement deterioration**
- **Maintenance and Structural Rehabilitation**
- **Cold In-Situ Recycling**
- **Cold In-Plant Recycling**
- **Pavement Investigation and Design**
- **Examples of Cold Recycling**

Road deterioration

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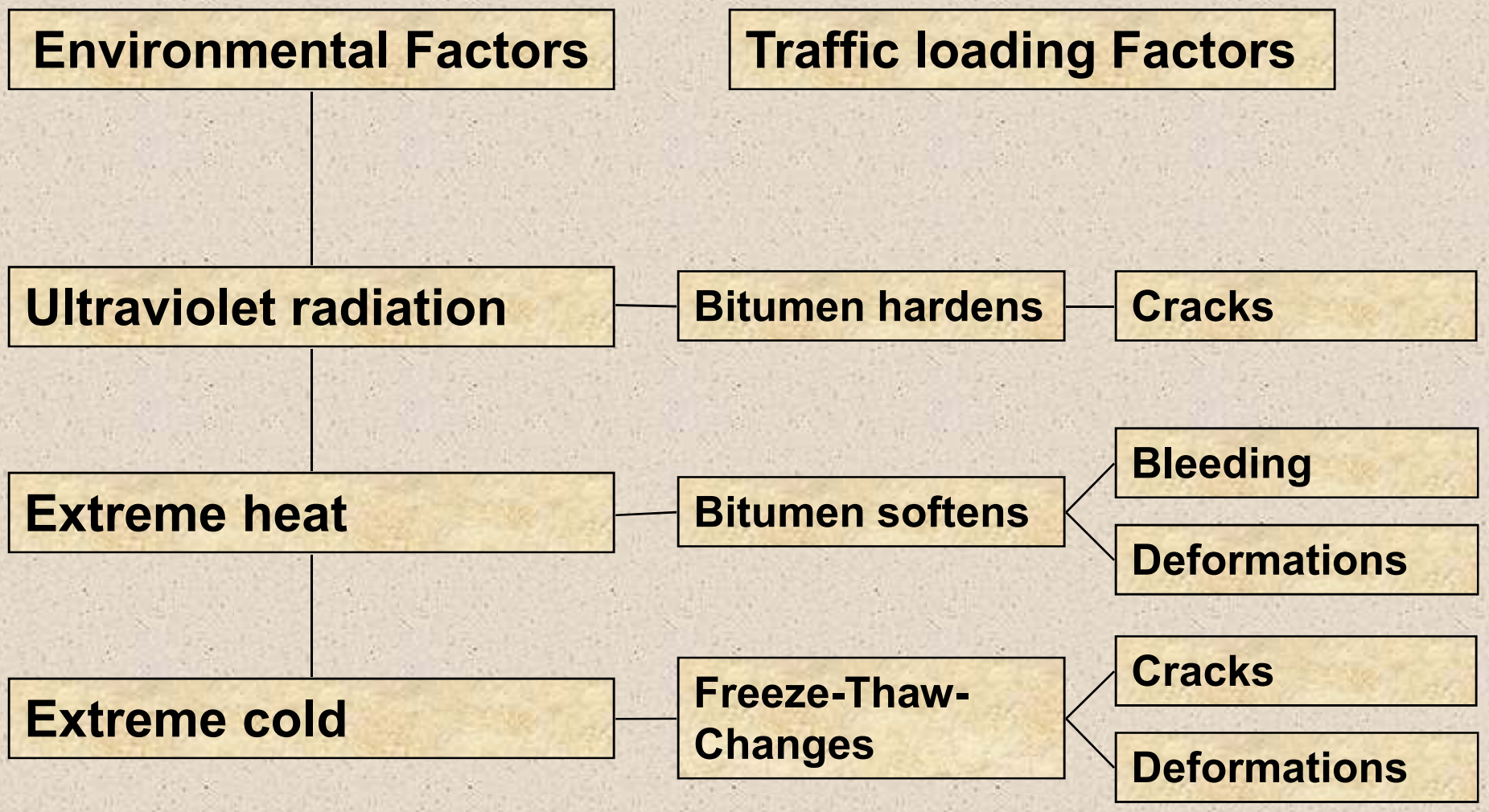

Road deterioration

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Road deterioration

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Road deterioration

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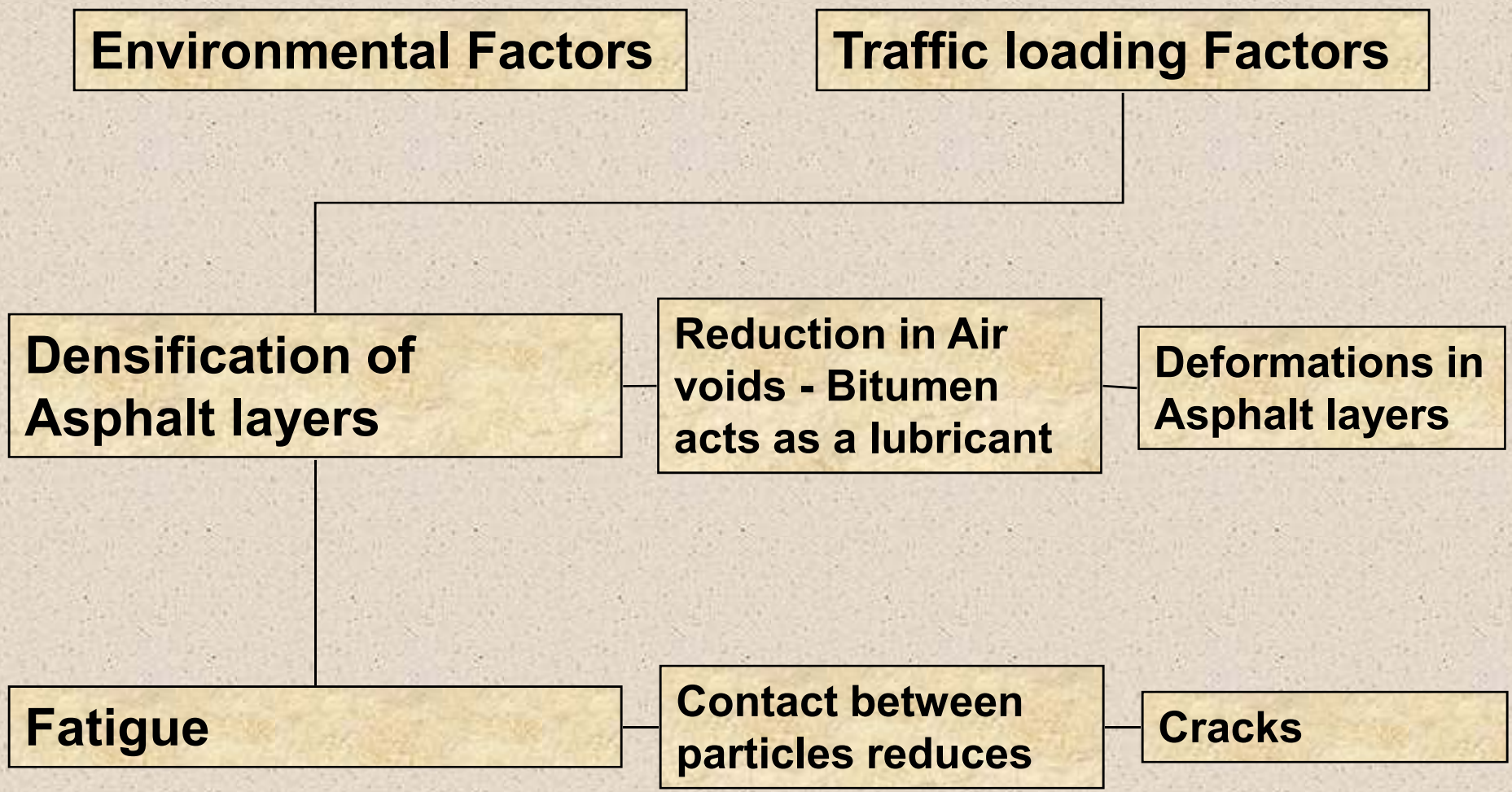

Road deterioration

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- Soil Stabilisation
- Pavement deterioration
- **Maintenance and Structural Rehabilitation**
- **Cold In-Situ Recycling**
- **Cold In-Plant Recycling**
- **Pavement Investigation and Design**
- **Examples of Cold Recycling**

Pavement maintenance

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Methods :

Thin asphalt overlay	Quick method, Elevation problems
Mill and replace	Quick method with modern Milling machines and pavers
Thin layer hot recycling	Quick method with modern hot recycling equipment and materials are being reused

Pavement maintenace

Methods:

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Thin asphalt overlay	Mill and replace	Thin layer hot recycling
Quick method, Elevation problems	Quick method with modern Milling machines and pavers	Quick method with modern hot recycling equipment and materials are being reused
		 (HIPAR)

HOT RECYCLER

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Panel Heating Machine

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Pavement maintenance/ Structural rehabilitation

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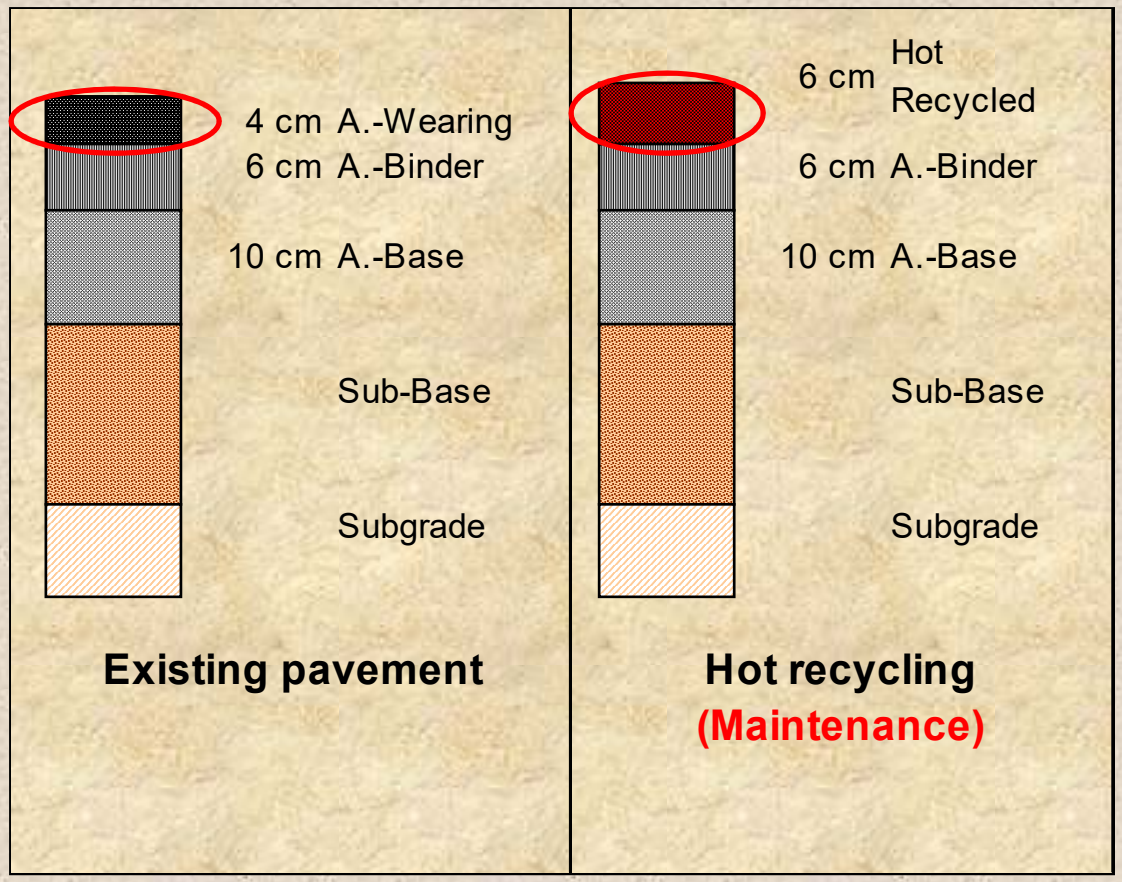

Difference between maintenance and structural rehabilitation

Structural rehabilitation

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Methods :

Total reconstruction	Expensive, Long construction time, Traffic accomodation
Thick asphalt overlays	Relatively quick method, elevation problems
Deep cold recycling	Price effective, Environmently friendly, Quick

Pavement maintenance/ Structural rehabilitation

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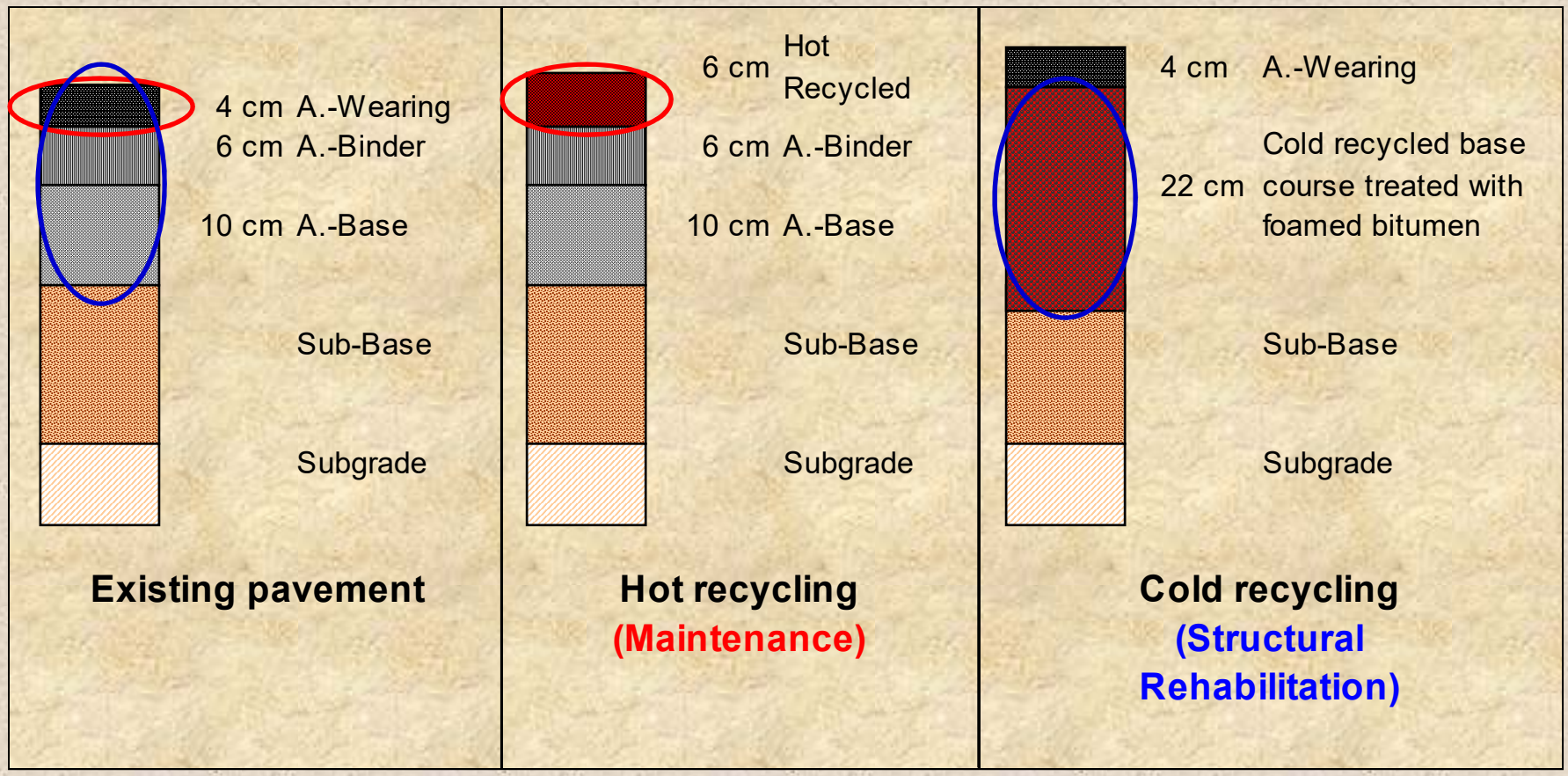

Difference between maintenance and structural rehabilitation

Structural rehabilitation

Methods:

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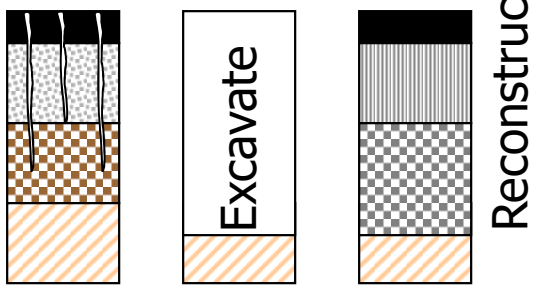
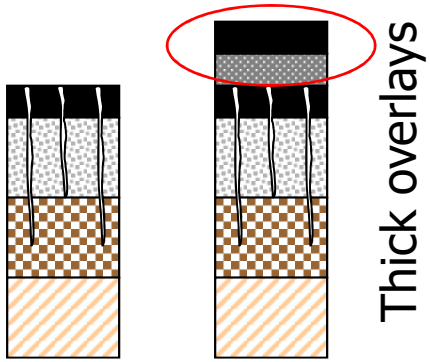
Total reconstruction

Expensive,
Long construction time,
Traffic accomodation



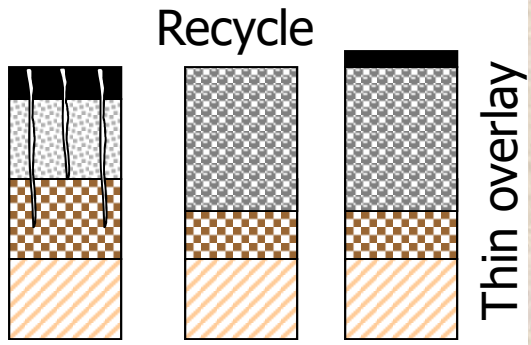
Thick asphalt overlays

Relatively quick method,
elevation problems,
reflection cracks



Deep cold recycling

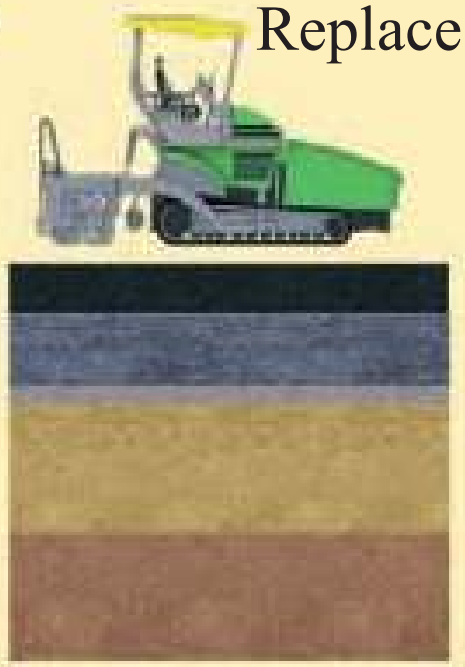
Price effective,
Environmently friendly,
Quick



Thick asphalt overlays

Mill off all sphalt

Replace asphalt



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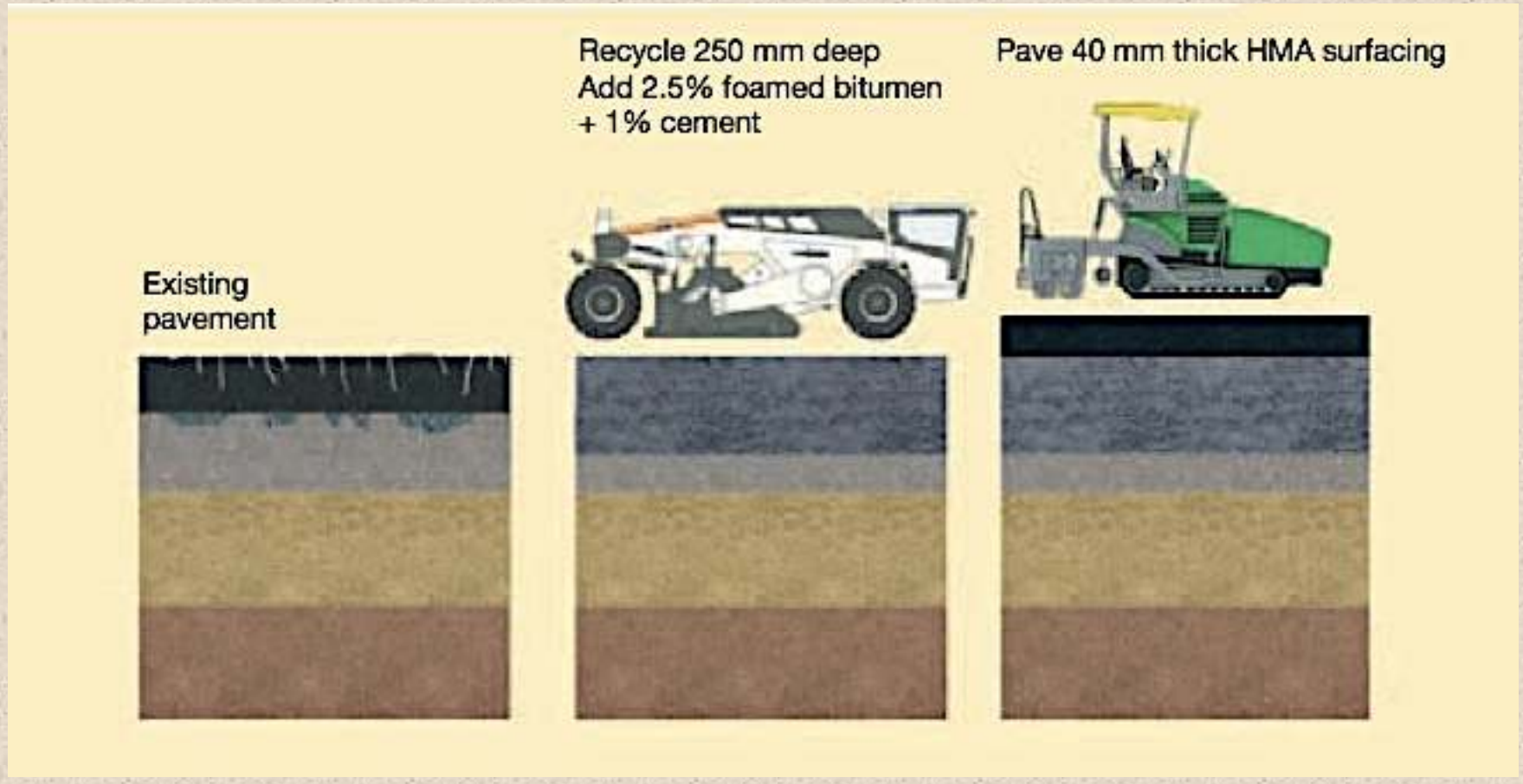
- Soil Stabilisation
- Pavement deterioration
- Maintenance and Structural Rehabilitation
- **Cold In-Situ Recycling**
- **Cold In-Plant Recycling**
- **Pavement Investigation and Design**
- **Examples of Cold Recycling**

In Situ Deep cold recycling



Cold recycling in situ

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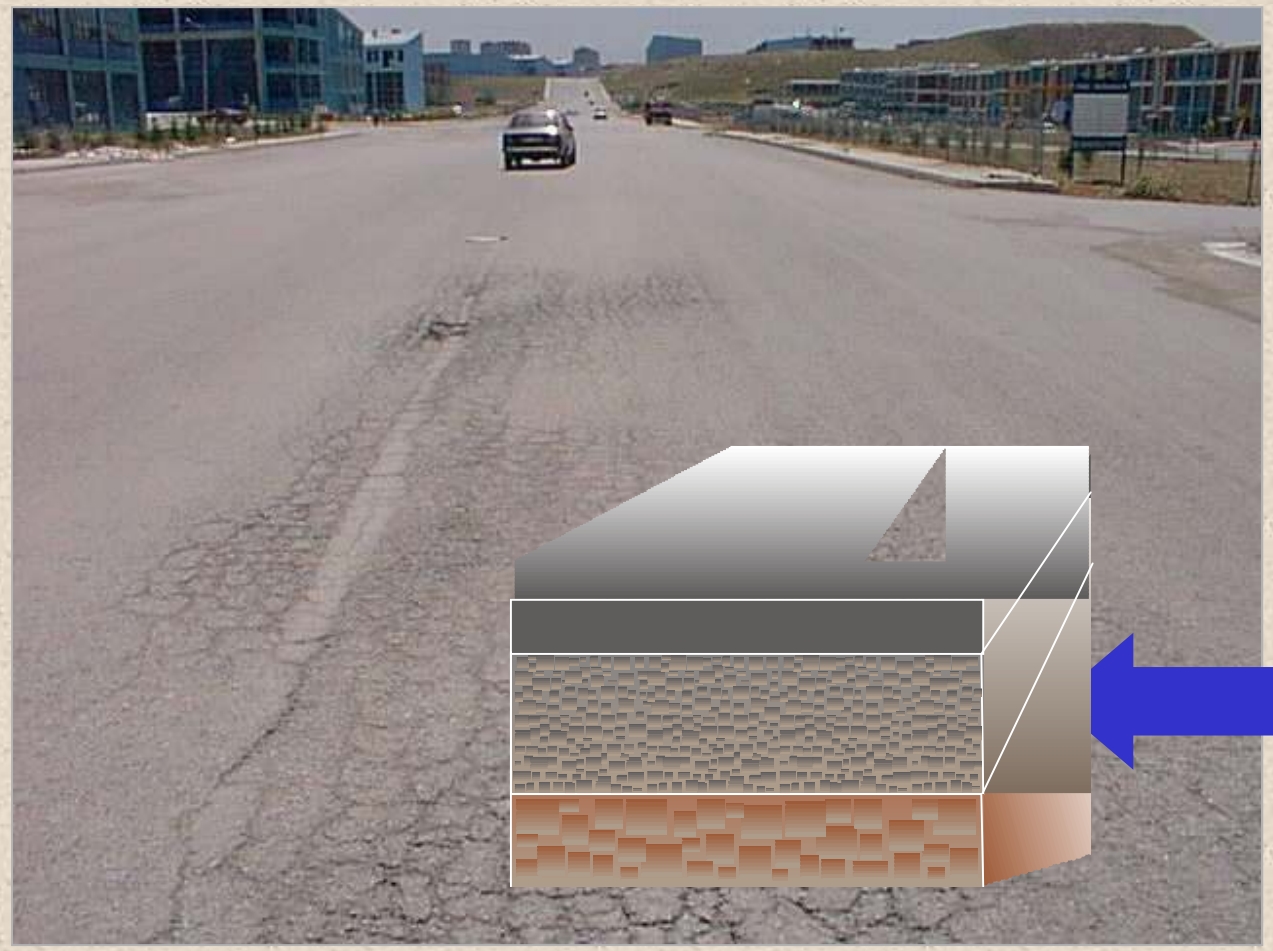

Typical Pavement for Cold Recycling

Cold recycling in situ

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Cold recycling in situ

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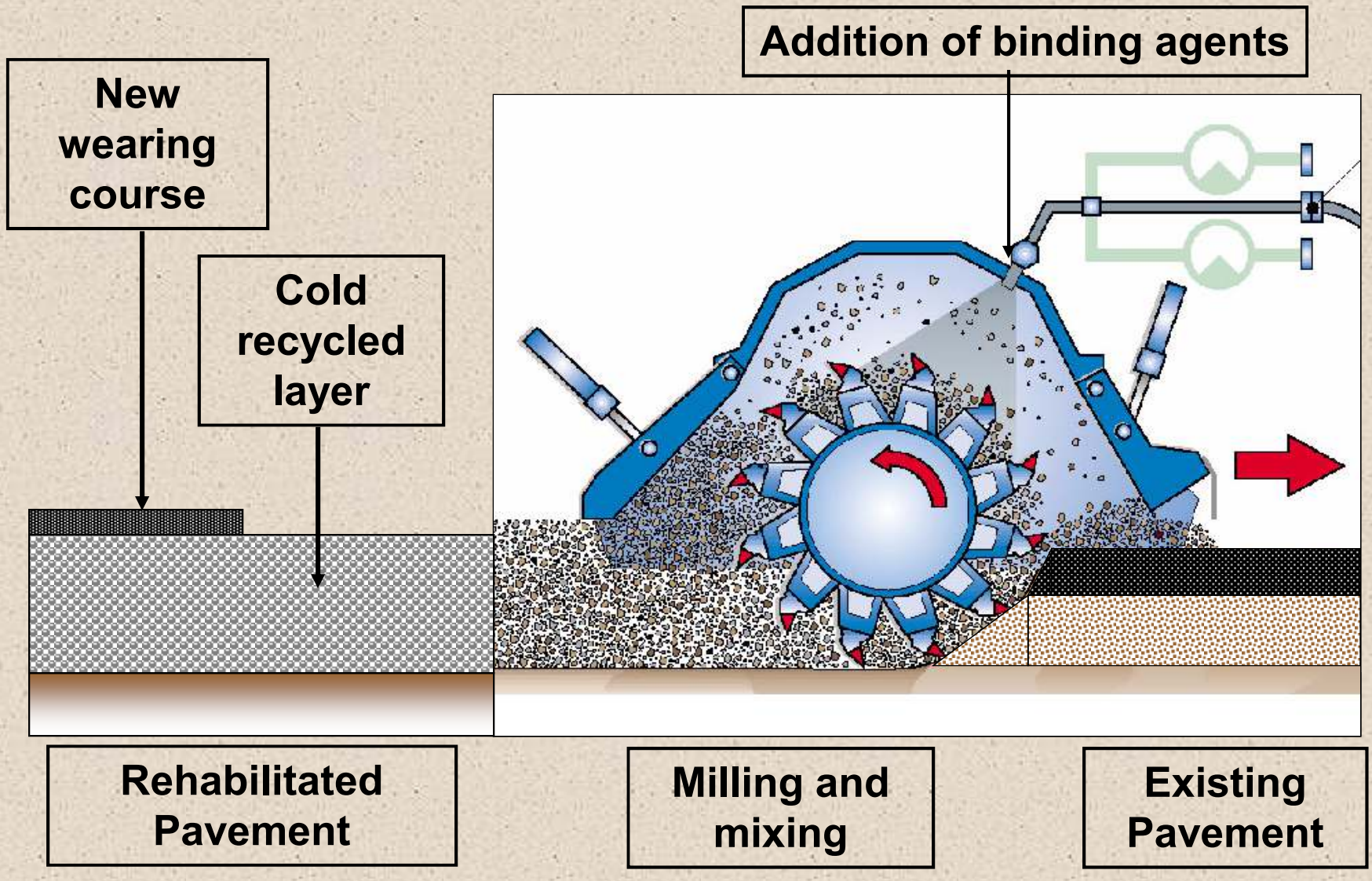

Cold recycling

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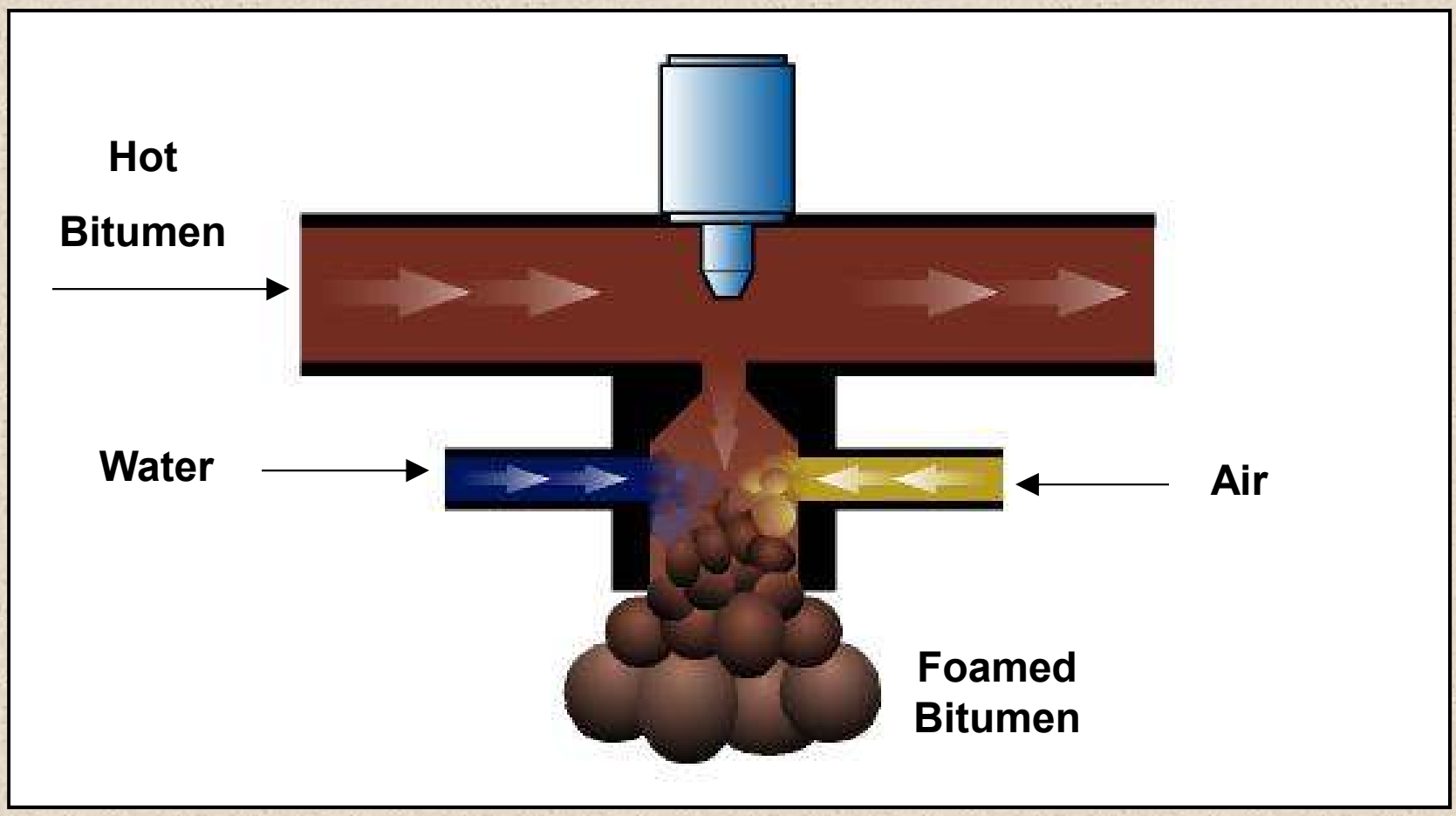

2 - 3% cold water injected into the hot bitumen will produce foam with an expansion of 10 to 20 times of the original volume

Cold recycling in situ

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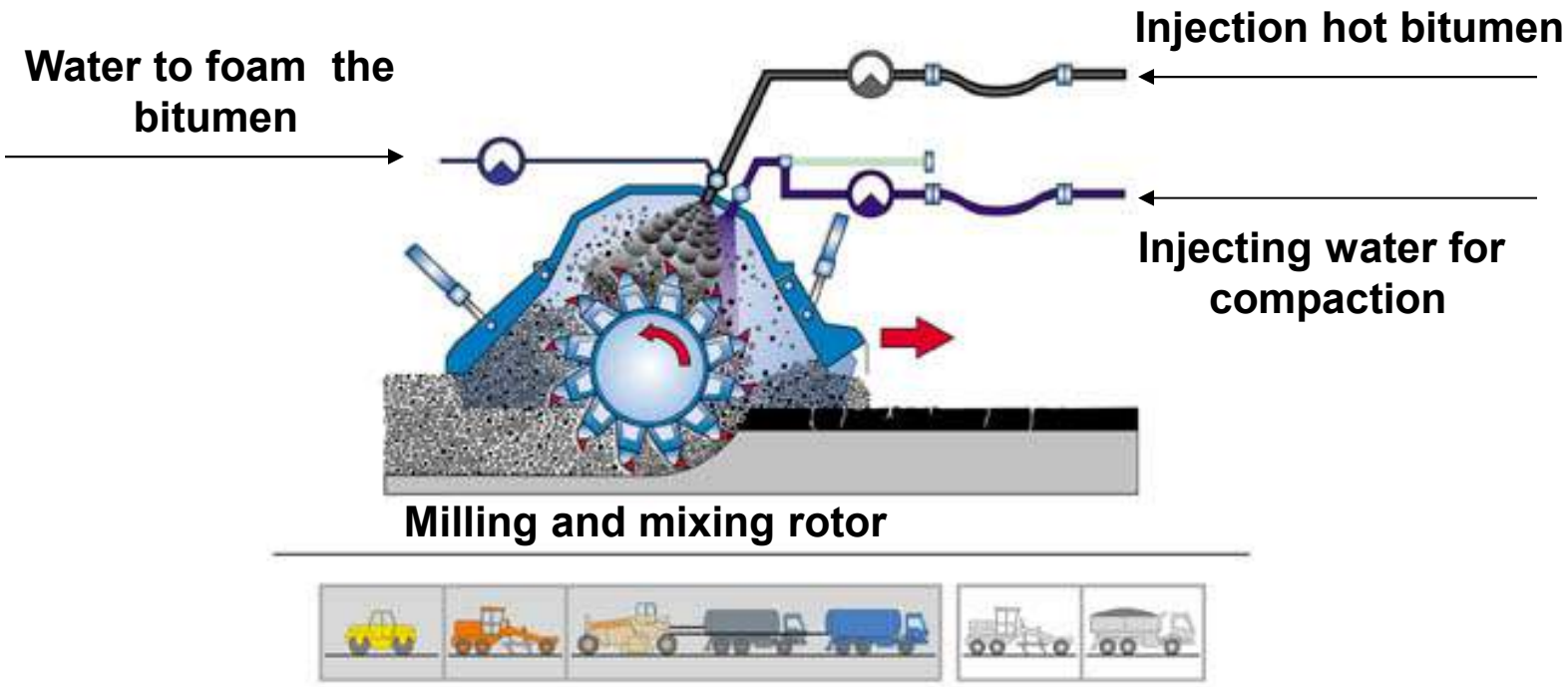

Schematic showing the process and machines used for cold recycling with foam bitumen

Cement slurry mixer WM 1000

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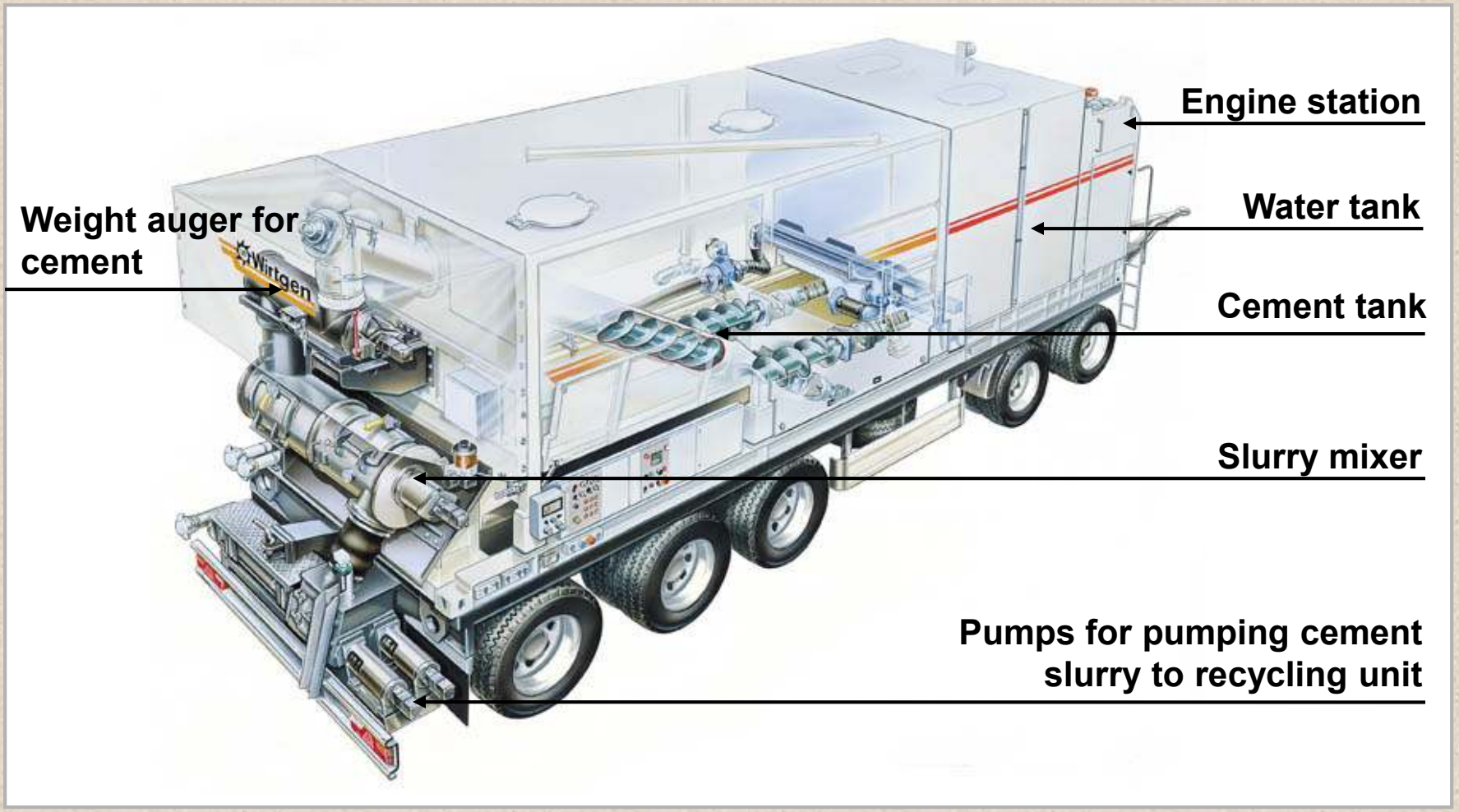

Schematic representation of the mobile cement slurry mixer

Treatment in-situ

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The mixed cement slurry is pumped directly into the Recycler WR 2500

Cold recycling in situ

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Cold recycling the asphalt and granular base layers by adding cement, water and foamed bitumen

Cold recycling in situ

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Upgrading an unbound gravel road
by cold recycling with foamed bitumen

Cold recycling in situ

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Deteriorated Road -
Longitudinal, Transverse and Crockodile cracking evident

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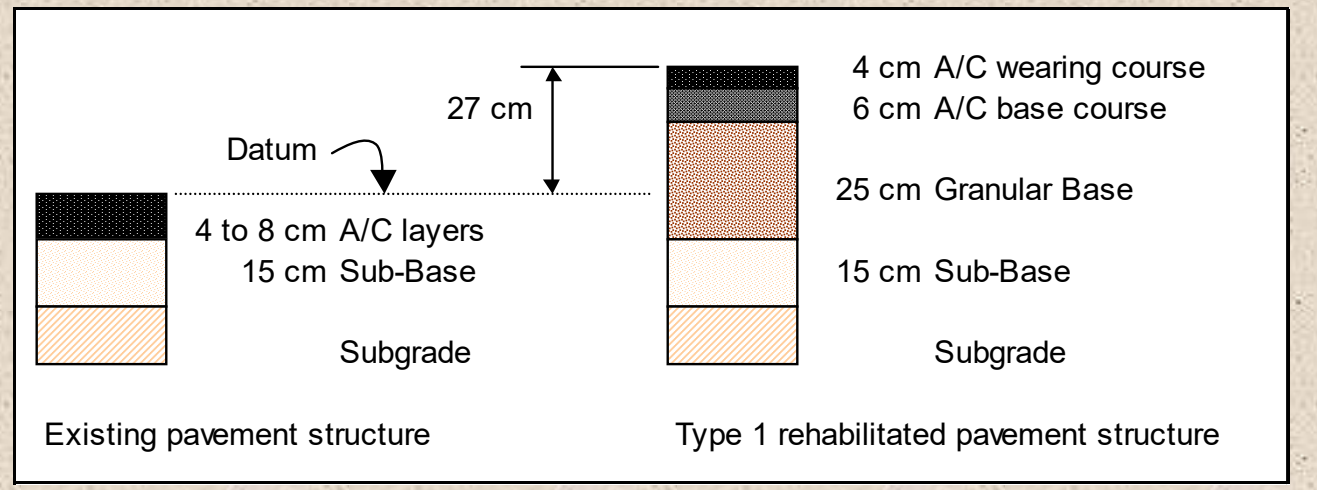

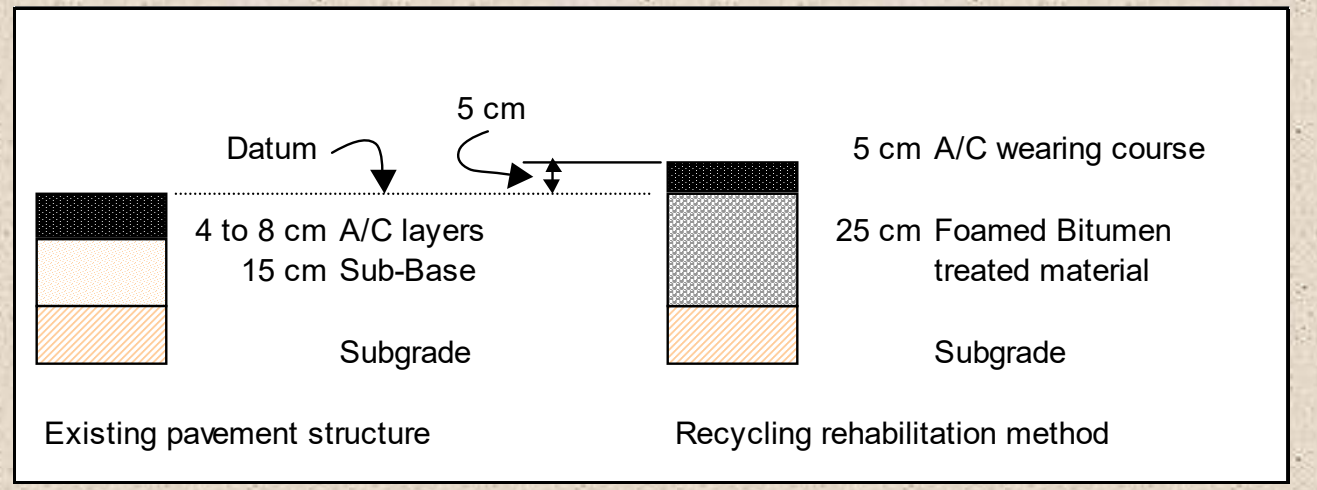

Cold recycling in situ

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Milling of the existing layer and then the recycling of asphalt and selected layers could start

- Soil Stabilisation
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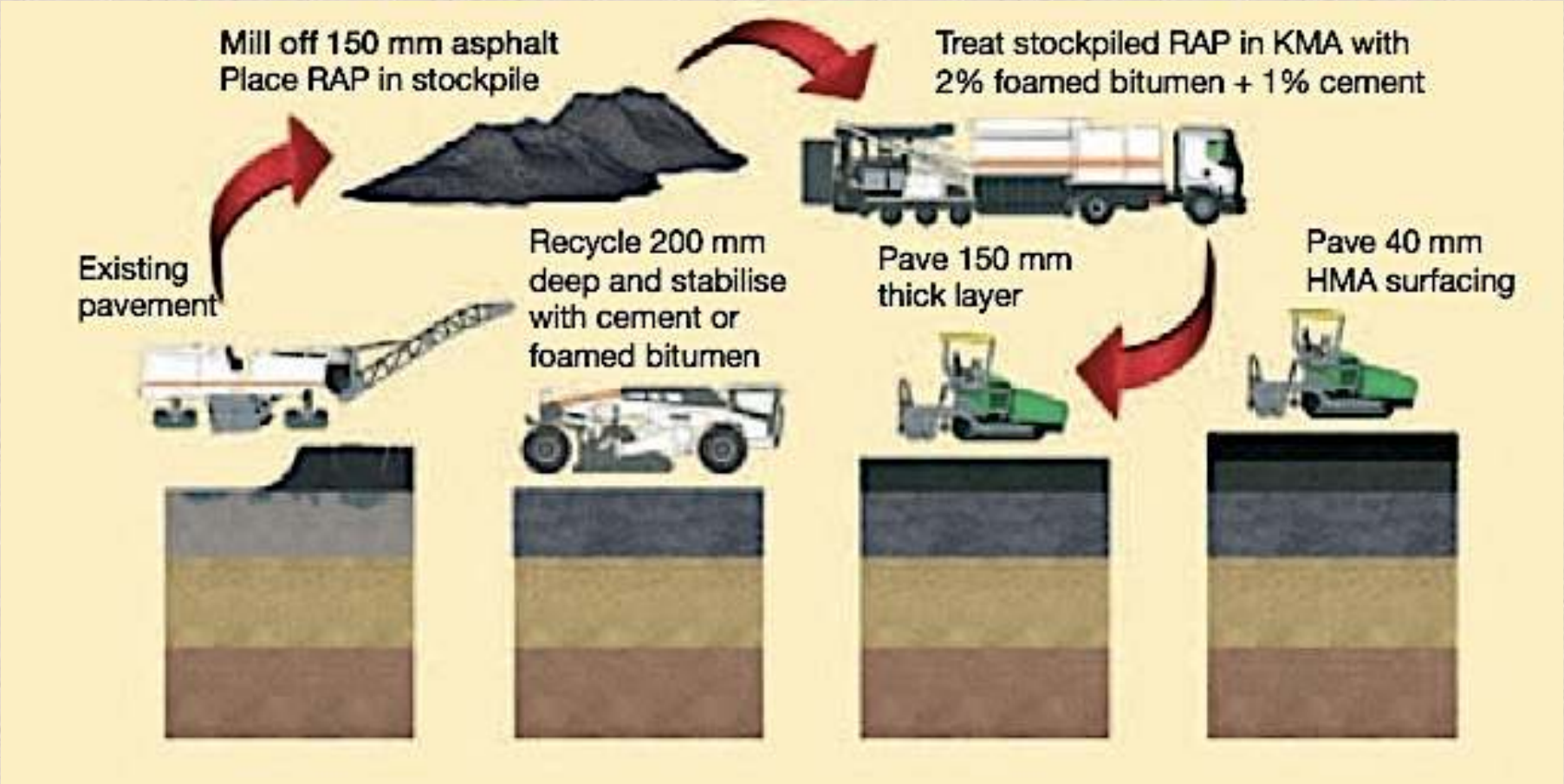
- **Cold In-Plant Recycling**
- **Pavement Investigation and Design**
- **Examples of Cold Recycling**

Cold In-Plant Recycling



Cold in plant recycling Binding Agents

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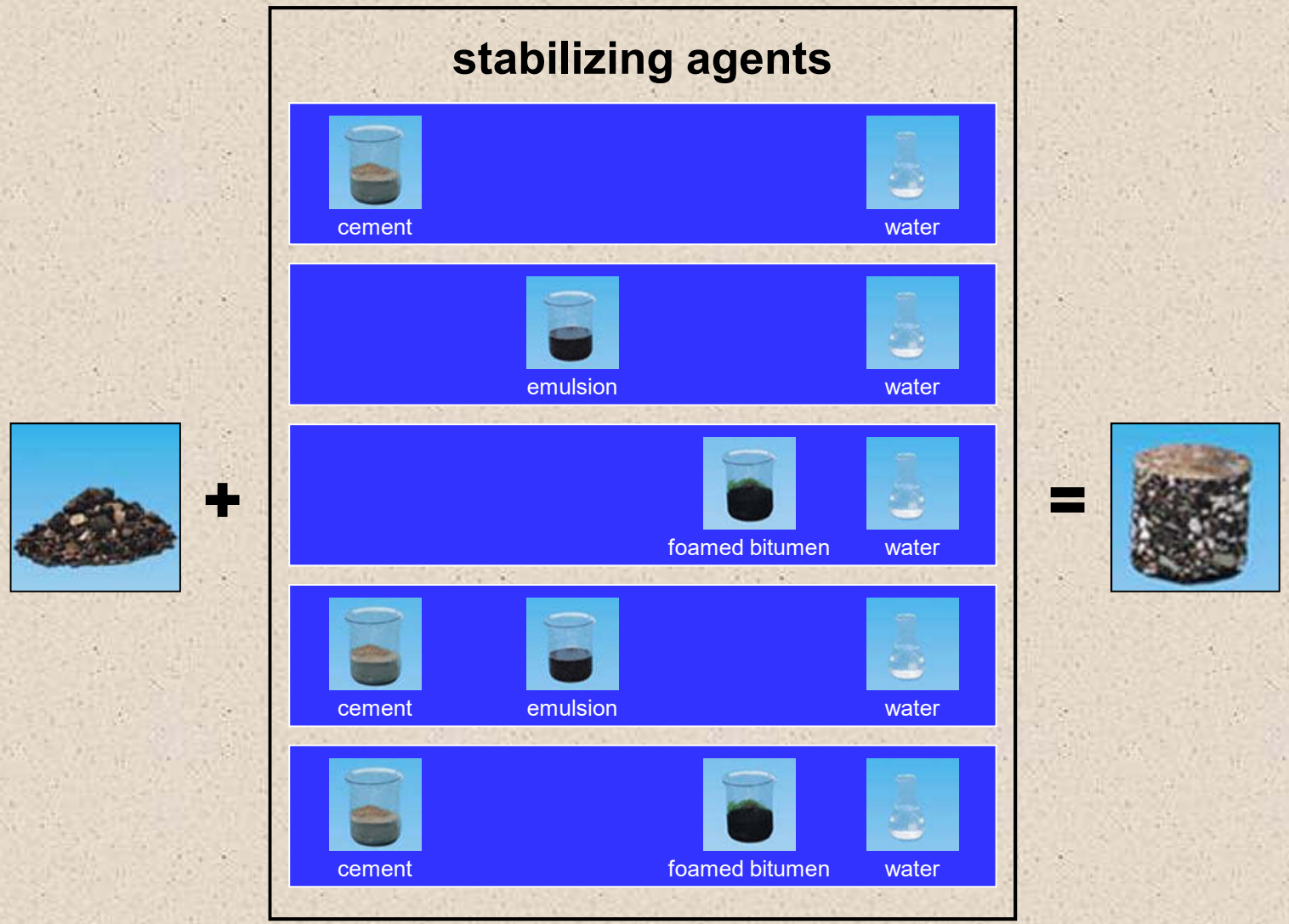

Cold Mixing Plant KMA 220
Technical Specifications

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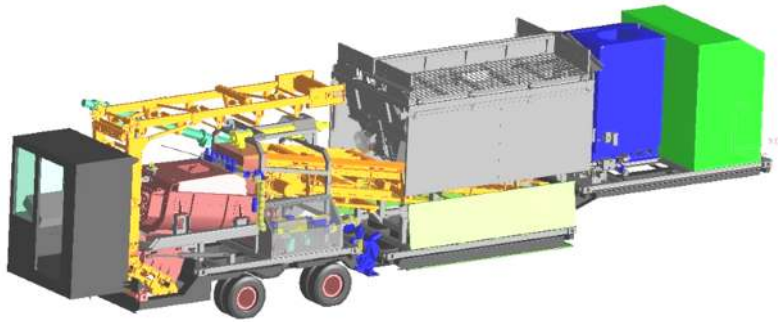

Transport configuration

Twin-shaft pug mixer	220 t / h
Aggregate Hopper	2 x 6 m³
Transport	13,4 m x 2,5 m x 4,0 m

Transport weight	30 t
Power Output	131 kW / 178 PS

Cold Mixing Plant KMA 200
Components

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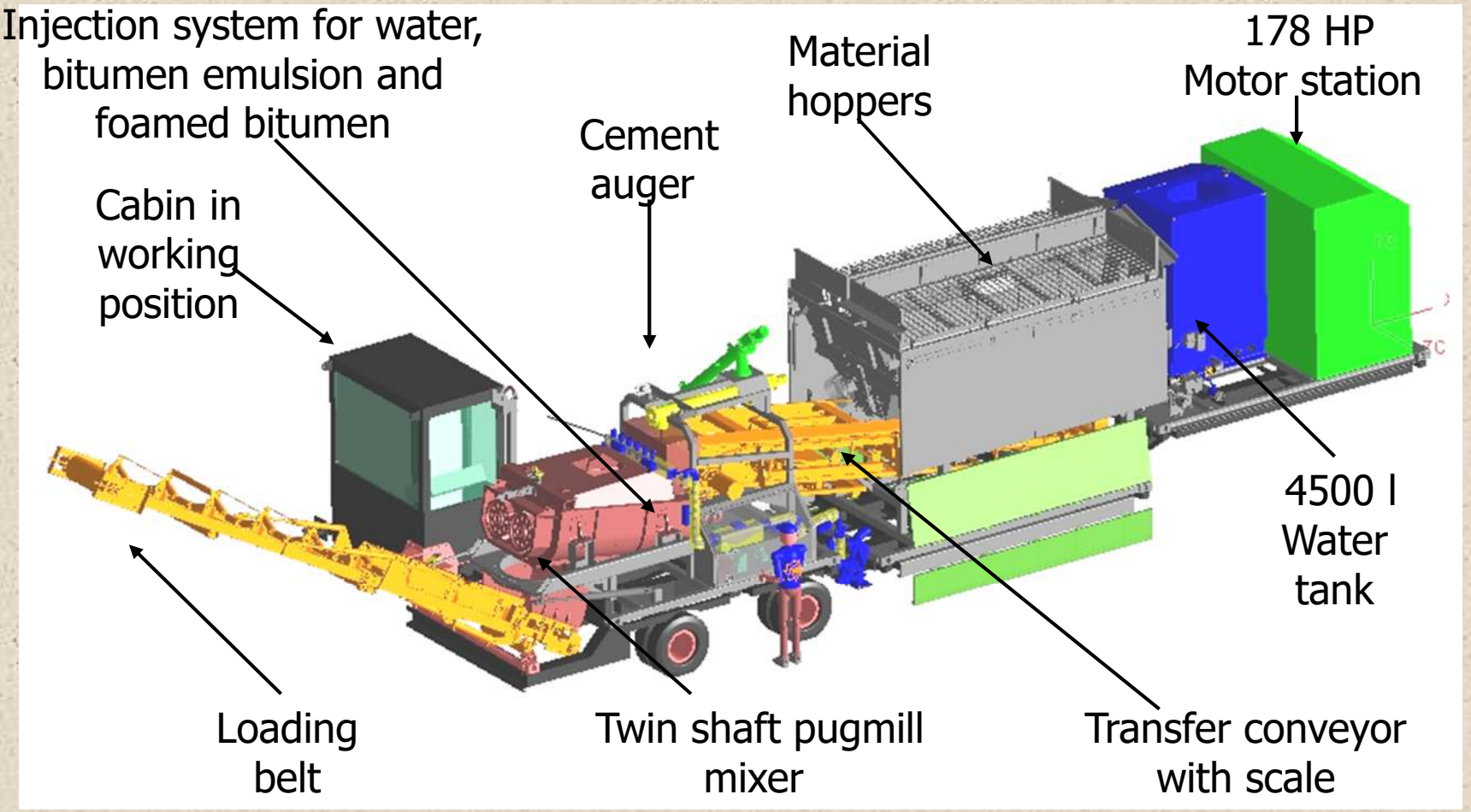

All components on one low-bed trailer

Pavement Investigation

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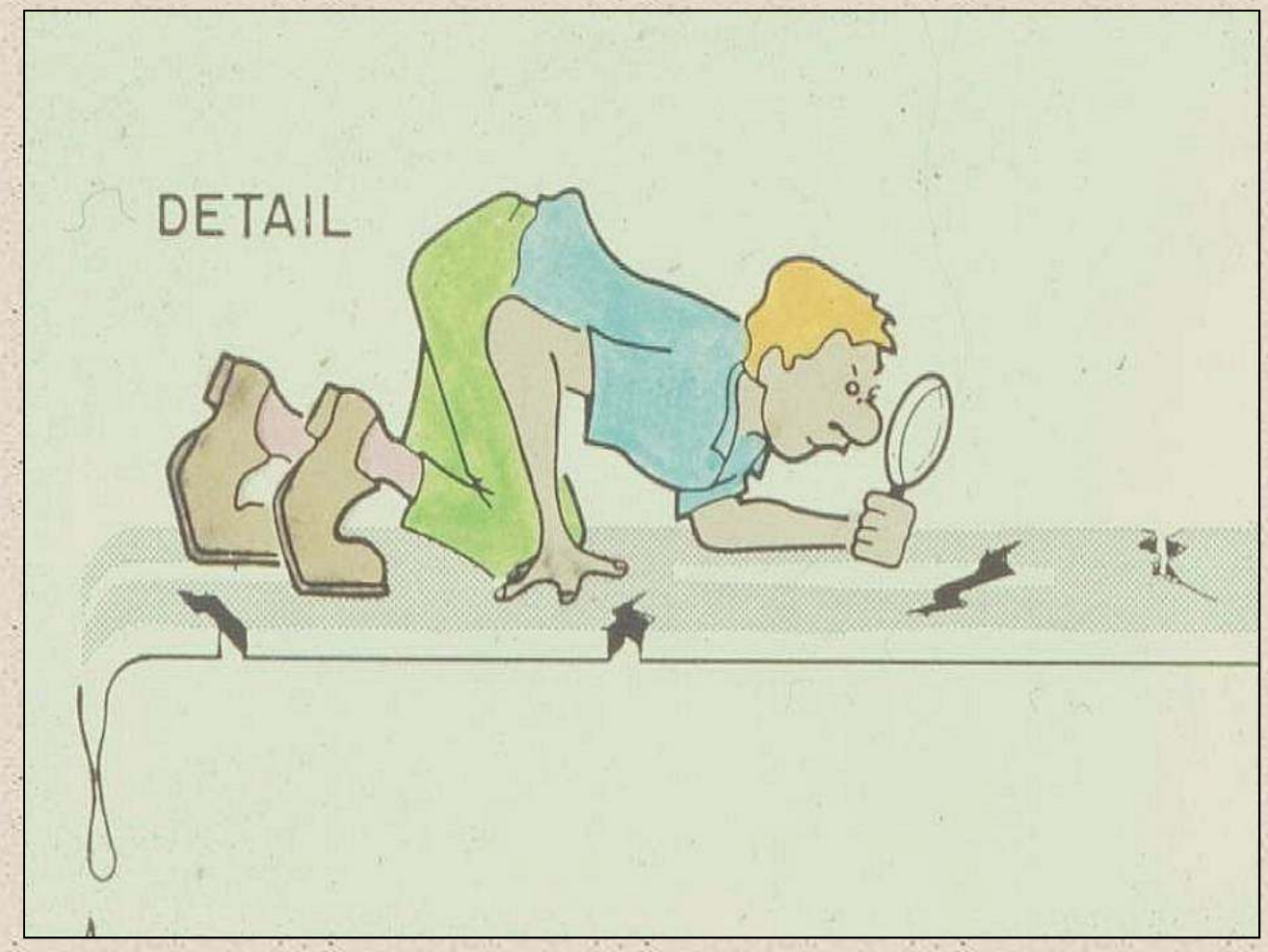

Pavement Investigation

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Walking, Looking

Recording damage

Project Data

- Length = ?
- Width = ?
- Damage patterns, etc

Visual Assessment and available information

Historical records, etc.

Pavement Investigation

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Milling Testpit

Investigating Layers

Test pits

Reasonably quick and cost effective method to check pavement buildup. Details like compaction, moisture content, type of material and thickness of layers can be determined. The material from the existing layers are then also used fot laboratory testing.

Pavement Investigation

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Core drilling

Core sample

Core Samples

Very quick, cost effective, and little disturbance to traffic

Pavement Investigation

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Plate bearing test

Plate bearing test

reasonably quick method of determining the soundness and strength of the entire existing pavement structure

Pavement Investigation

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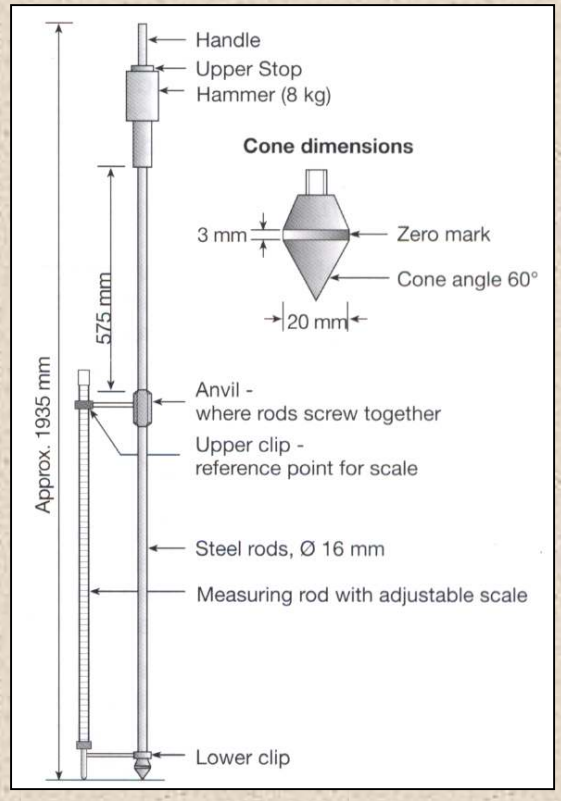

Dynamic Cone Penetrometer

very quick method of determining the soundness, strength and thickness of each layer. Results can be used for design method.

Pavement Investigation

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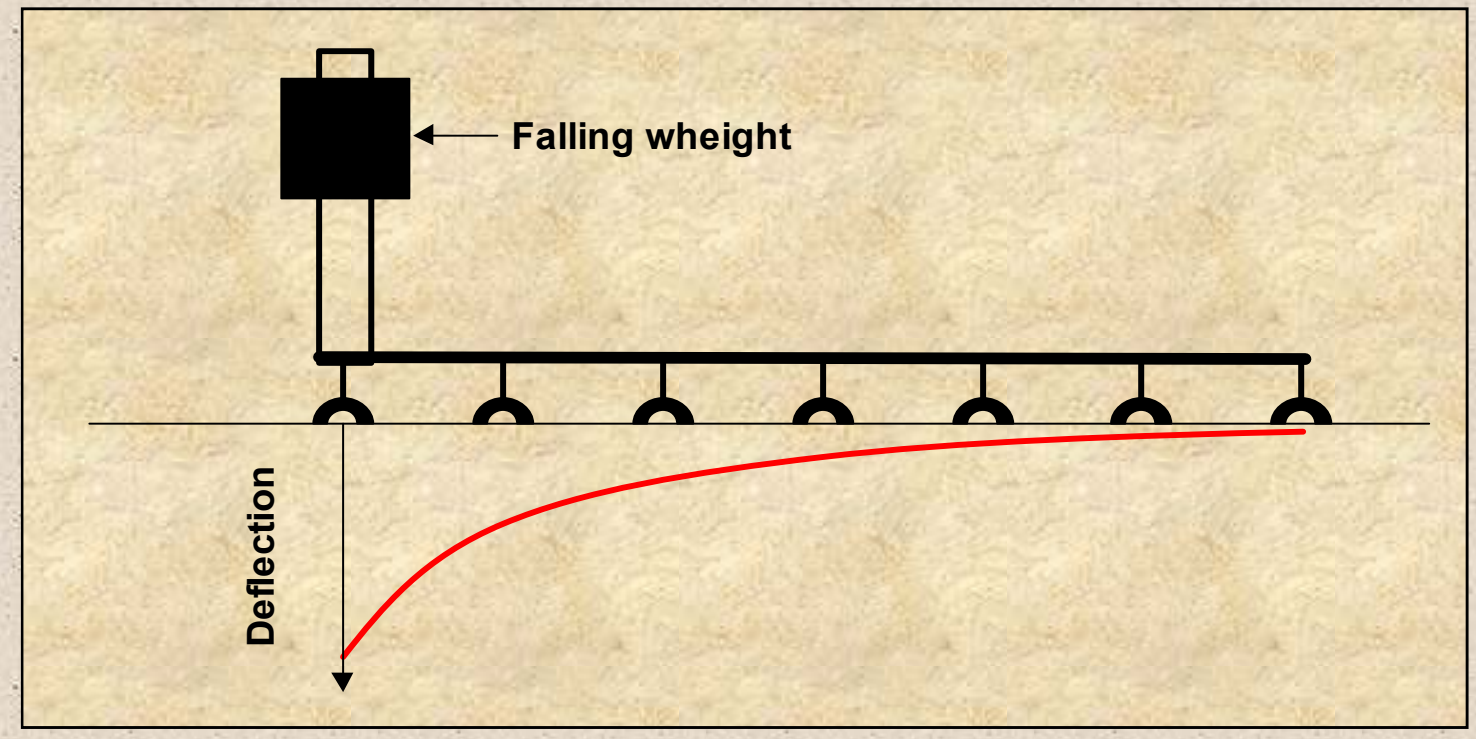

Deflection measurements

with the falling weight deflectometer (FWD) the deflectionbowl radius is determined for the entire pavement structure. Results are used for the deflection design method.

Job Site Reports

Recycling in Situ Method

Rehabilitation of Emirates Road(E-611)

Emirates Road

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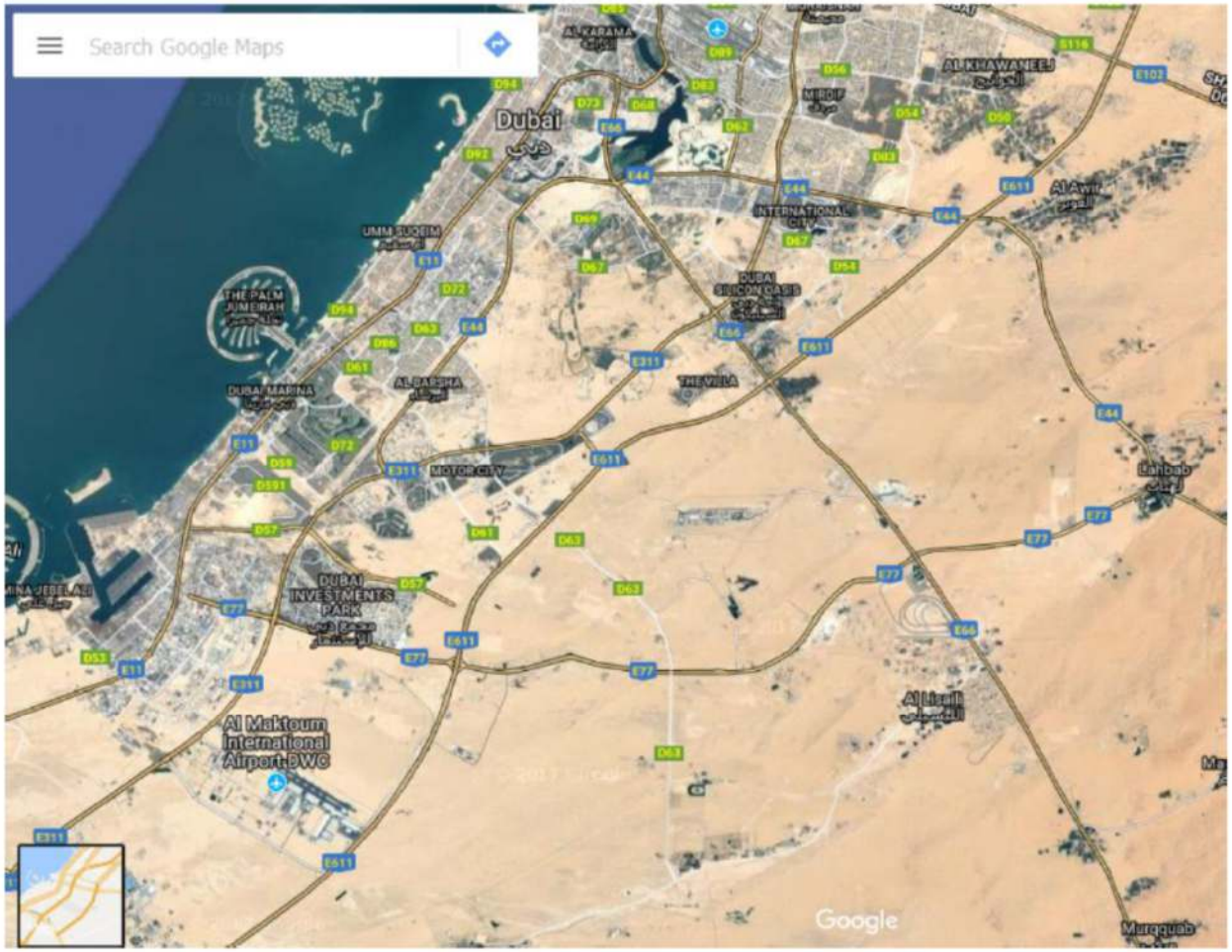
Length: 29.5 Km - Width: 4 m



Highway project in Emirates

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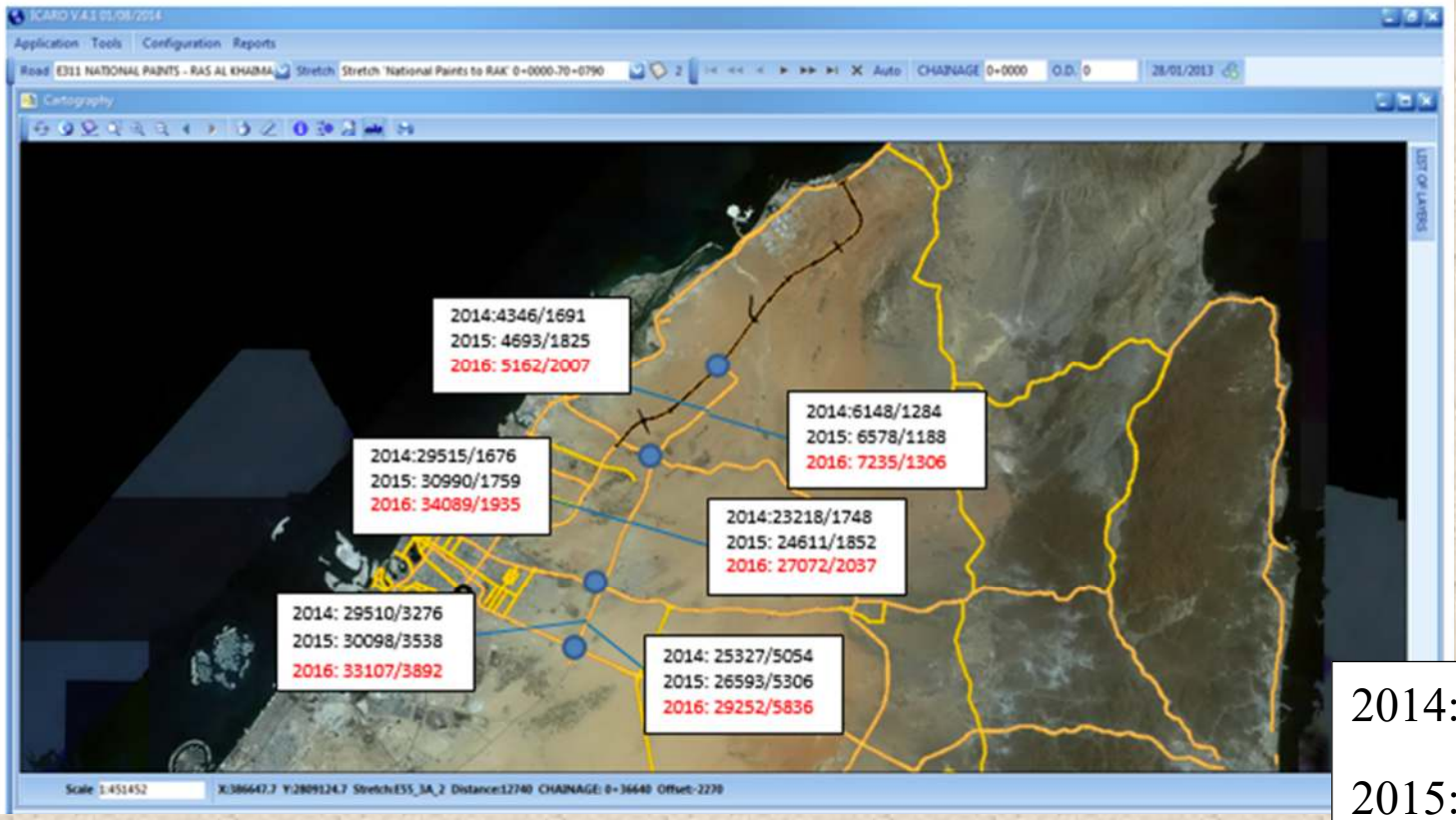
TRAFFIC VOLUMES PER ROAD

Road E-611 (Emirates Road) (Kalba road – E88 – E55 – E311)



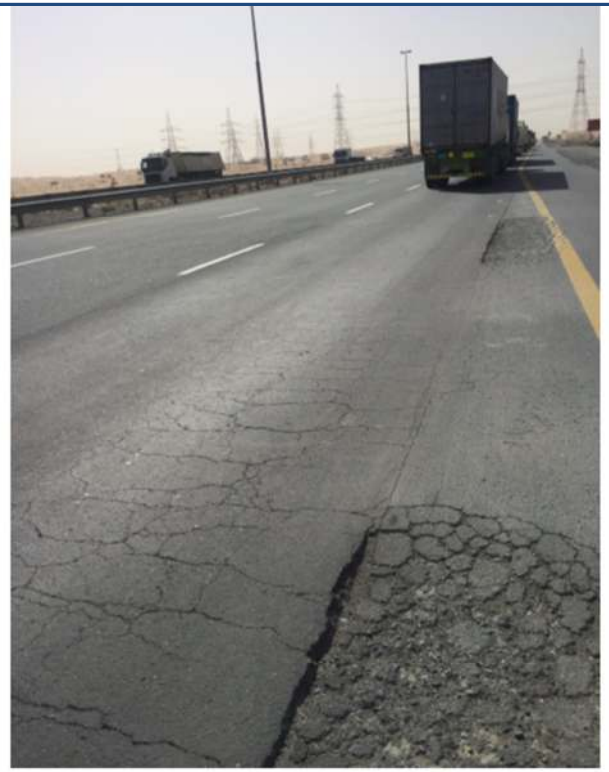
2014: ADT / HWADT

2015: ADT / HWADT

2016: ADT / HWADT

Highway project in Emirates

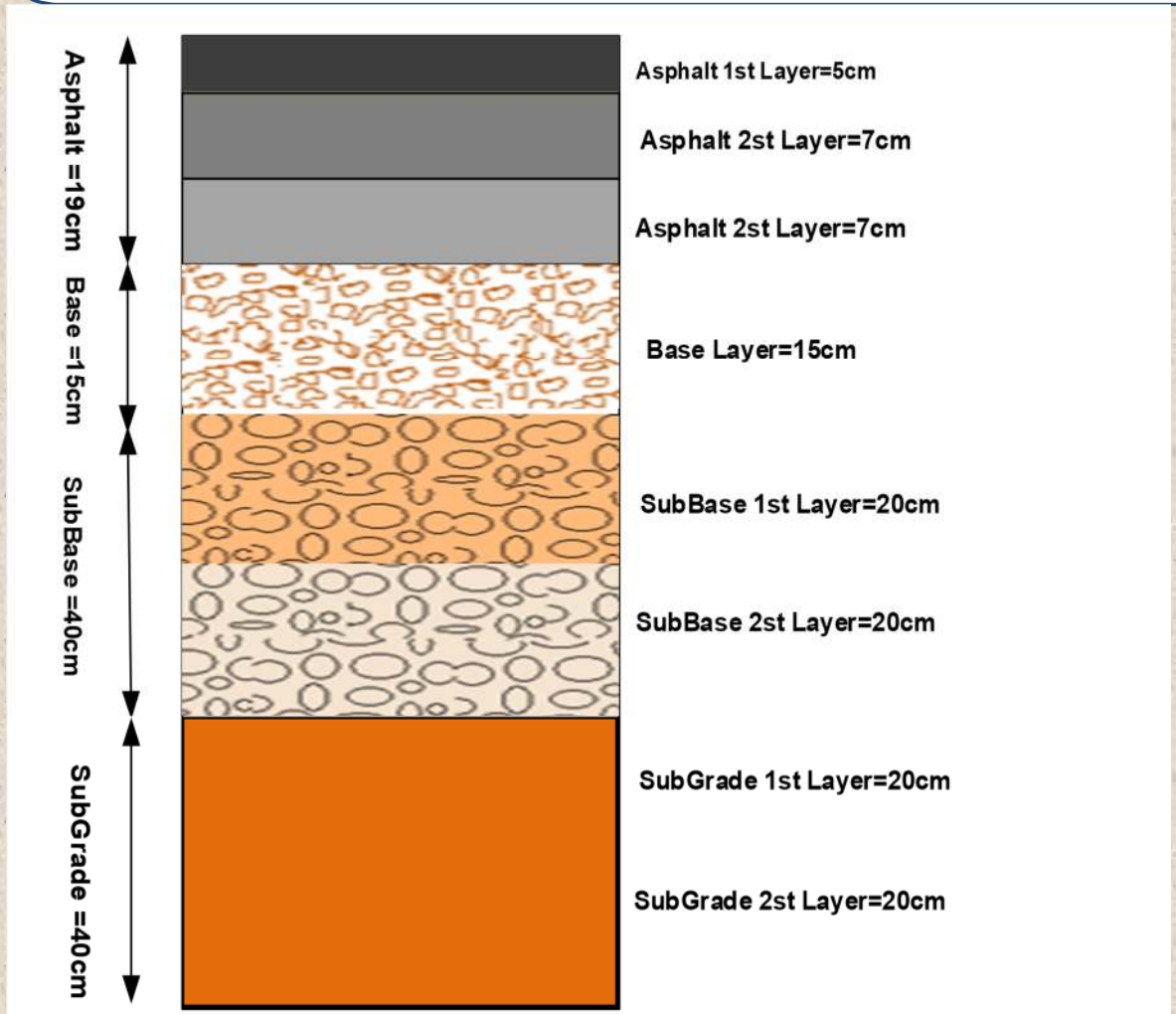
Evaluation of existing Distress



The major distress of road pavement is alligator cracking (Fatigue cracking)

Highway project in Emirates

Evaluation of road pavement

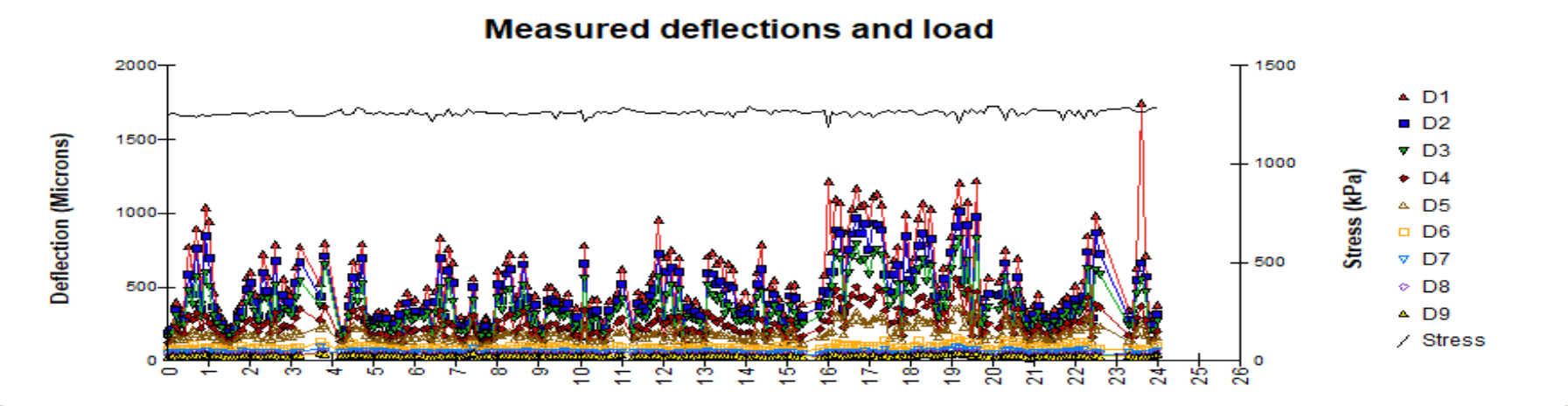


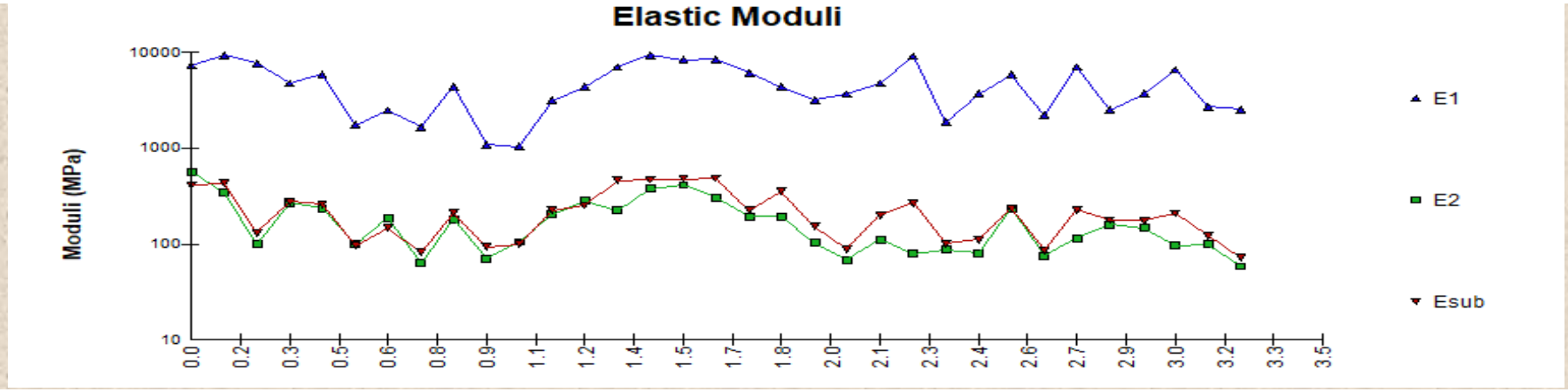
Highway project in Emirates

Evaluation of road pavement

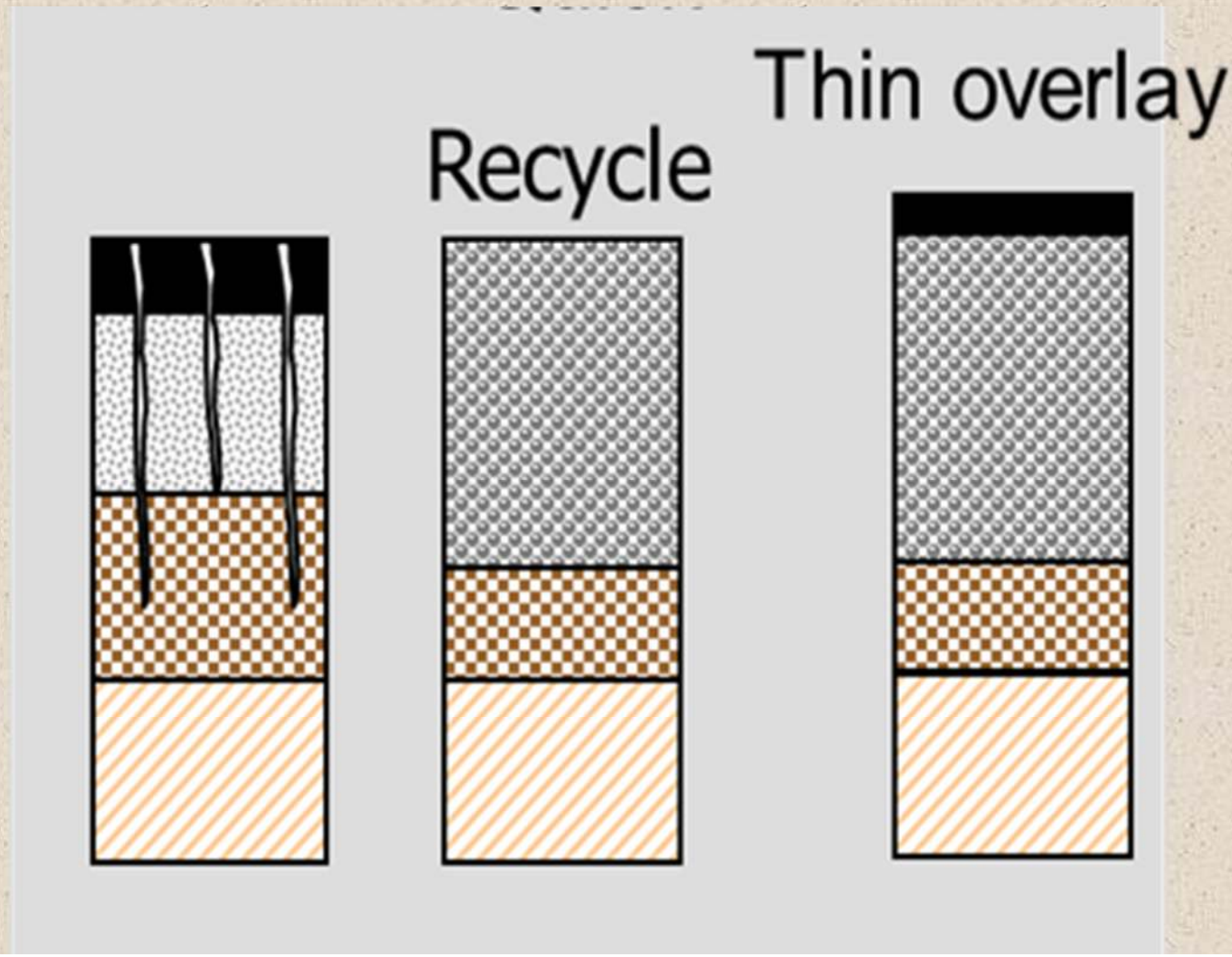
Highway project in Emirates

Non-Distractive Test

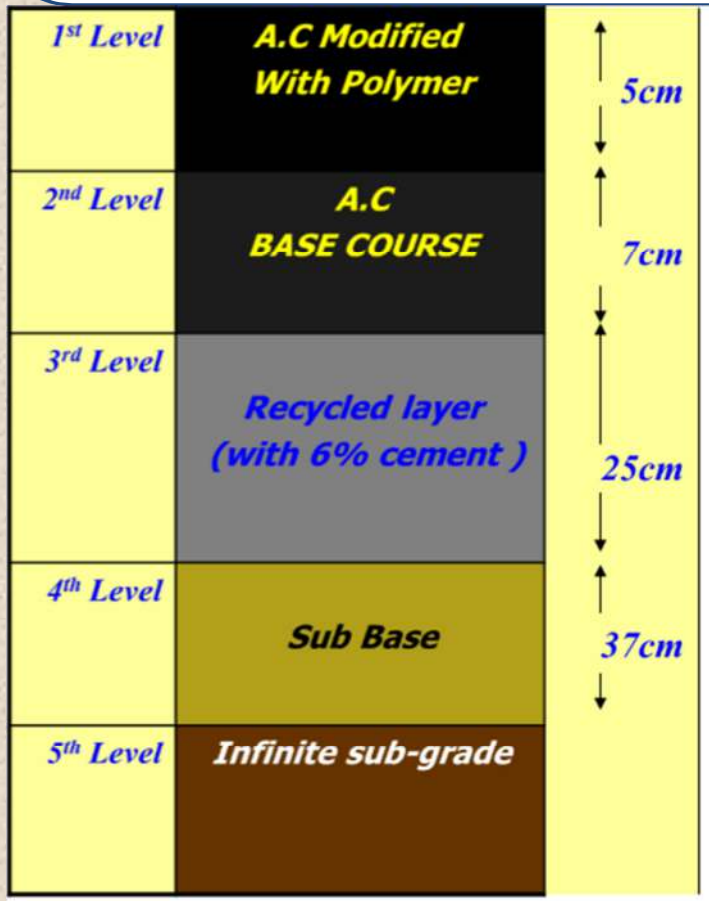




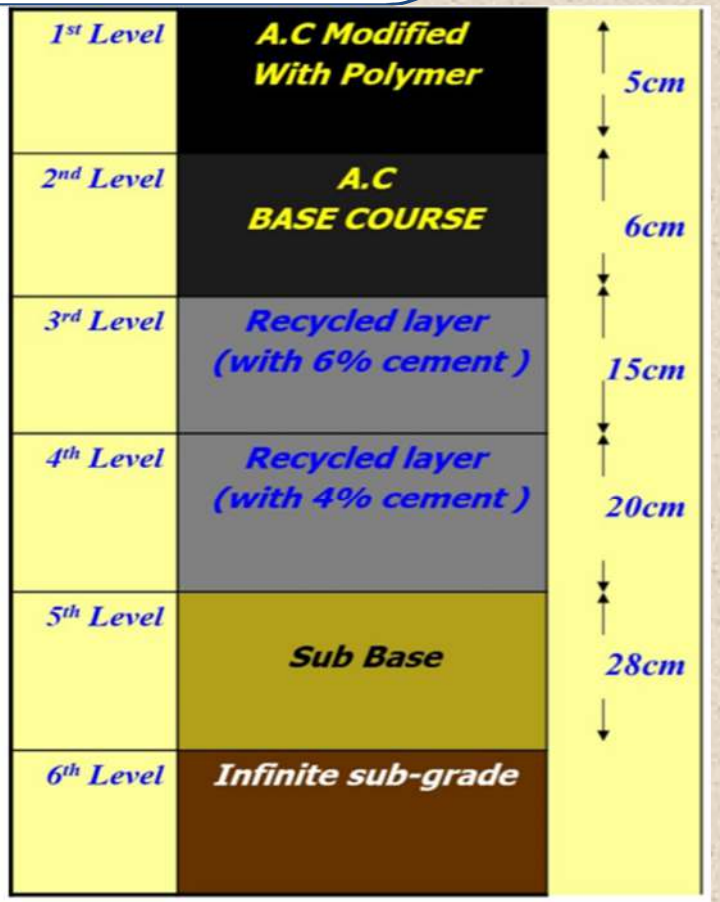
Road rehabilitation Options



Road rehabilitation Options



Option 1



Option 2

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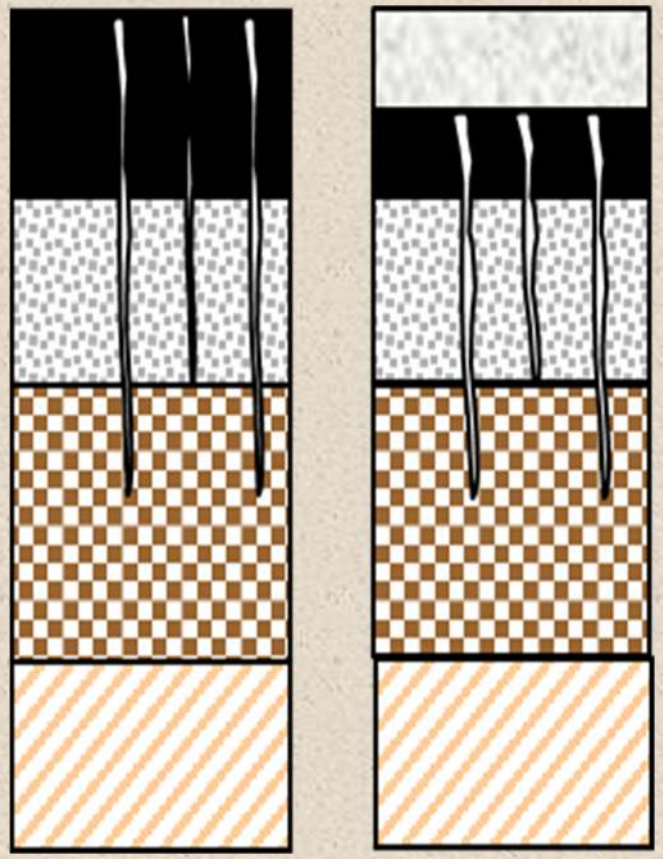
First Step-Milling

Milling 13cm

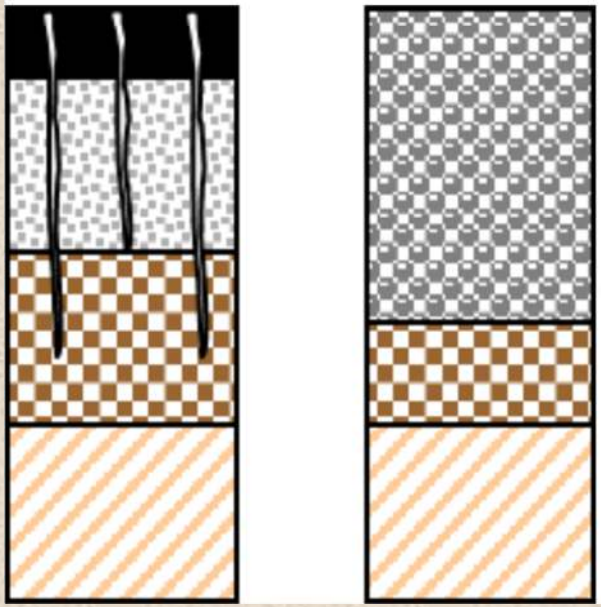


Highway project in Emirates

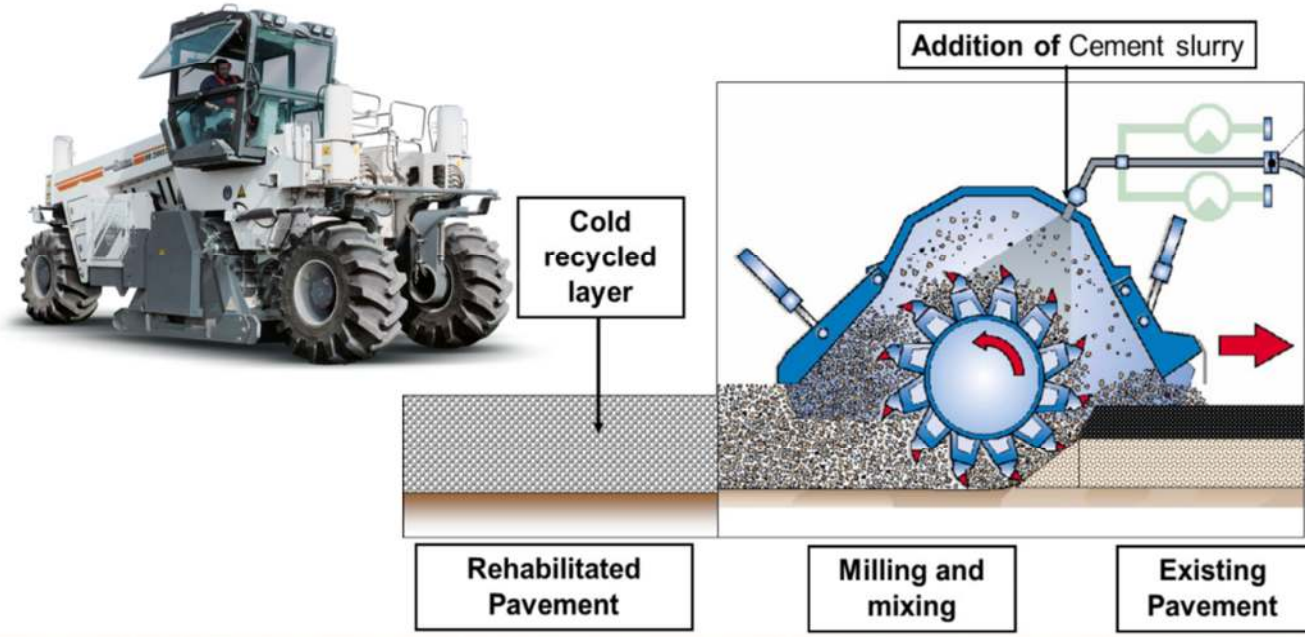
Cold Recycling With Cement

Option 1

Recycling 25 cm with 6%

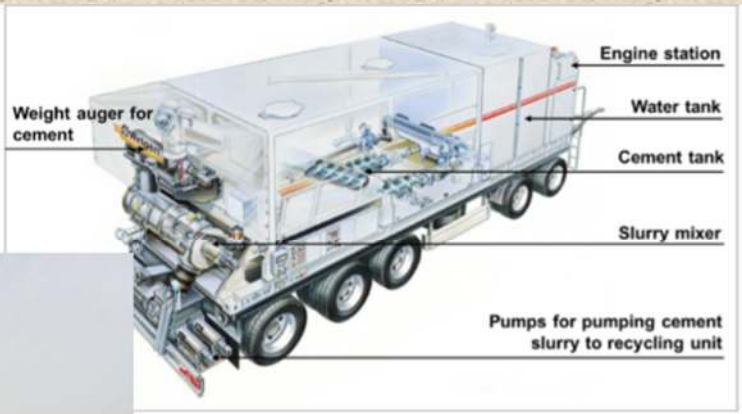


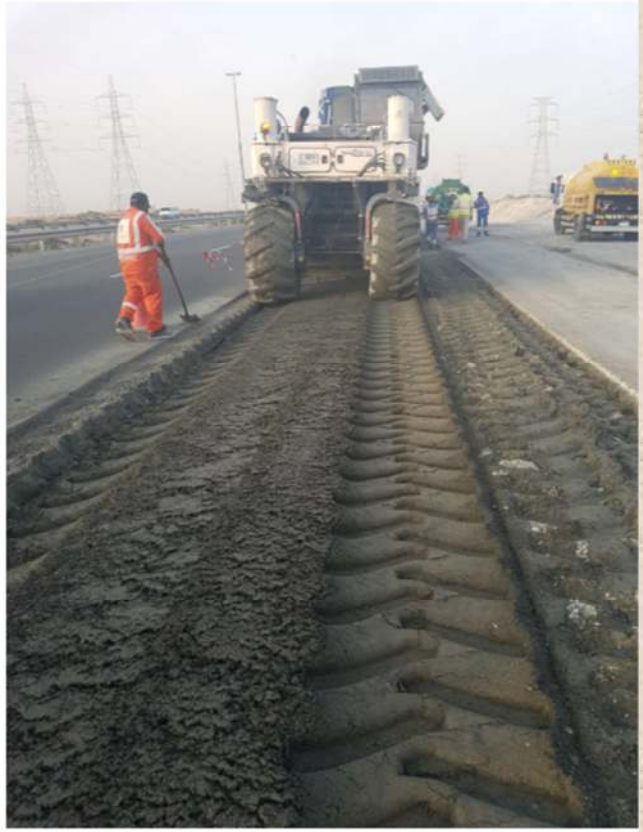
Option 2



Highway project in Emirates

Cold Recycling With Cement





Highway project in Emirates

Leveling. Final Compaction And AC overlay

Highway project in Emirates

Leveling. Final Compaction And AC overlay

Highway project in Emirates

Operation in the shortest time

Highway project in Emirates

Highway project in Emirates

Reasons for Cold Recycling

Cost Saving

- Reduction or Elimination of transporting materials
- Re-use of materials
- Personel cost saving due to significant shorter construction time
- Energy saving as no heating of materials is required

Time Saving

- Modern Recyclers capable of high production rates - 8000 m² / day are possible
- Less risk of accidents if construction time is reduced

Highlights of Cold Recycling

- **Environmental:** Reuse of materials
- **Layer quality:** Stabilising agents are accurately added by microprocessor
- **Structural integrety:** The problem is addressed
- **Short construction time:** Wirtgen recyclers capable of high production
- **Traffic safety:** Recycling train can be accomodated in one lane
- **Road widening:** Roads are easily widened with the existing available materials
- **Cost saving:** Usually 20 % to 30 % cost saving compared to conventional methods

Any questions?