

LISBOA 2010 16th World Meeting

MAY 25/28



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**Paper No
469**

Establishment of Management System for Maintenance Activities in Urban Road Network Case study in Benghazi - Libya

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Pavement Maintenance Management system

- **Planning tool**
- **Collects and monitors information on current pavement conditions**
- **Evaluates alternative repair strategies**
- **Prioritizes selected repairs**

Background



Sharing the road



- ❖ Traditionally, the core of engineering activity in the roads sector has consisted of the design and construction of new roads.
- ❖ With a large network of highways in place, the need for preservation and efficient maintenance of existing highways is growing.
- ❖ To keep roads in good or acceptable condition through their design life for the least expenditure, highway agencies are resorting to Pavement maintenance Management System (PMMS).

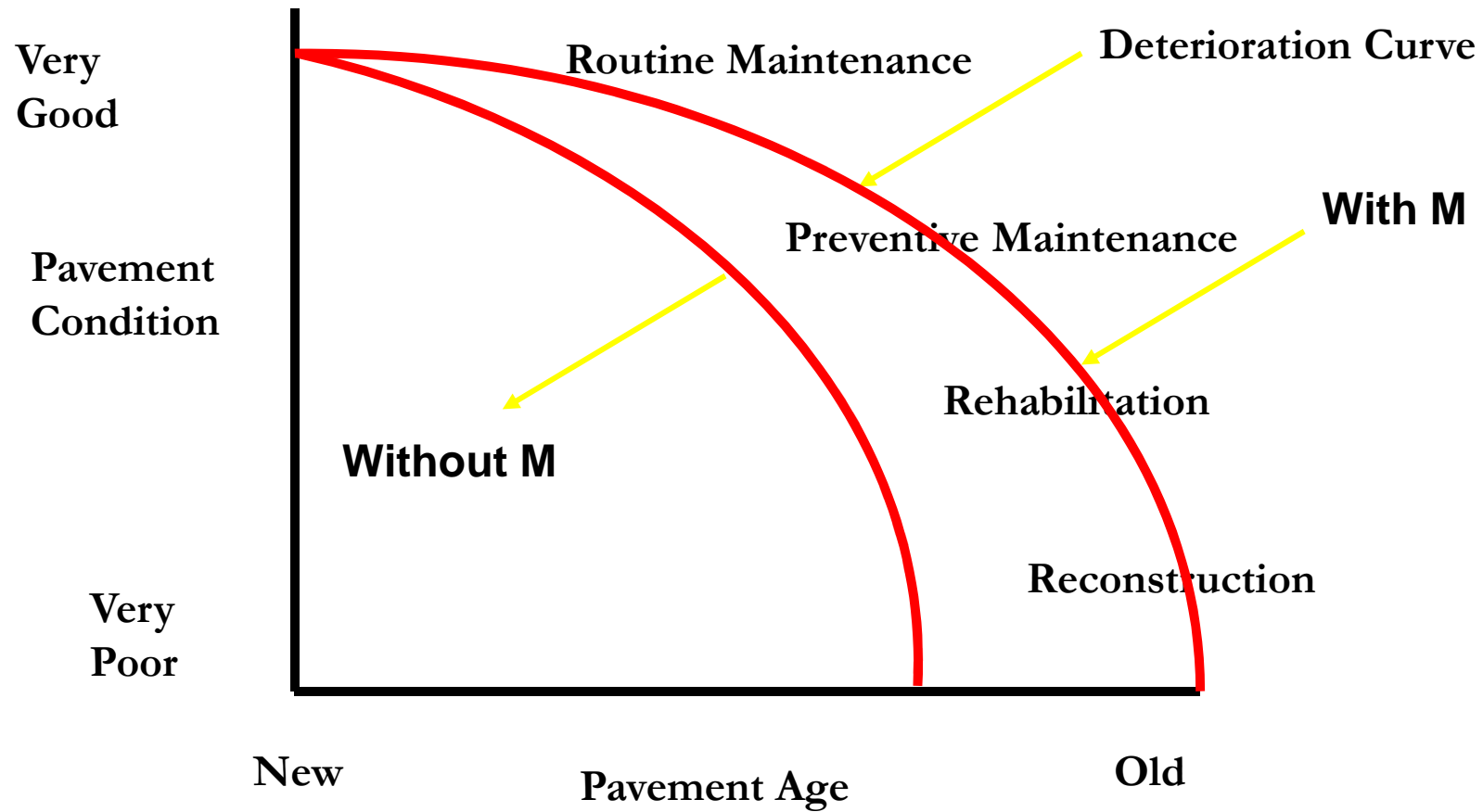


How PMMS Works

- **Select the type of repair that is most cost-effective for the condition of pavement.**

- **Selection is based upon the current condition of the pavement.**

Deterioration Curve





Study Objectives

- ❖ Presenting the existing situation and condition of pavement network at the city of Benghazi.
- ❖ Presenting the importance of pavement maintenance management system and its role in optimizing maintenance activities expenditure.
- ❖ Providing authorities related to road networks with developed system for pavement maintenance management appropriate to conditions prevails in the city of Benghazi.

The City of Benghazi Highway Network

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Study Problem

The city of Benghazi pavements have the following current threats:

- ❖ Increase rate of deterioration (pavements deteriorate fast)
- ❖ Overloading of vehicles (no commitment to the legal loading)
- ❖ Rapid traffic growth (high increase of vehicle ownership)
- ❖ Poor maintenance (wrong implementation, etc)
- ❖ Limited resources (funds, equipment, materials, etc)
- ❖ Insufficient information for decision-making

Existing Road Condition in Benghazi

The roads can be classified into four existing conditions:

1. Roads in good condition
2. Roads in acceptable condition
3. Roads in bad condition
4. Roads in failed condition



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Roads in good conditions



Roads in acceptable conditions



Roads in bad conditions





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Roads in failed conditions





Maintenance & Repair

Inventory & Condition Survey



Therefore, establishing a PMMS computer programme that suits Conditions in Benghazi city is essential .



Decision making



Data Analysis



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What a PMMS Computer Programme Can Do

The PMMS computer program can provide answers to questions related to each one of the following:

1. Pavement Condition

Which sections are with failed, poor, good conditions, etc?

2. Pavement Maintenance

Which sections require localized maintenance, global maintenance , overlaying or reconstruction?

3. Treatment Cost

What are the treatment cost of each section, each road or overall?

4. Priorities

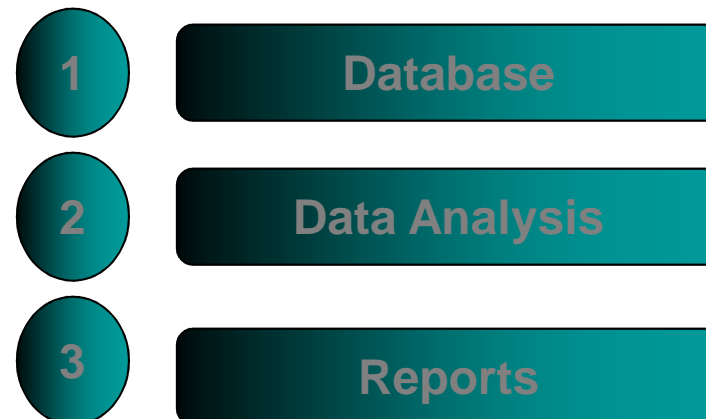
Which roads should be repaired first?

PMMS Software Components

3 Different Types of Data Go into the Program



Feed into 3 Basic Components of the Software



Proposed Benghazi PMMS Computer Program Components

PMMS consists mainly of two major components:

- 1. An information system : to collect, store and manage data and information.**
- 2. Decision support system : to process and analyze these data for decision making.**

The proposed PMMS components based on the following two management software:

- ❖ **Microsoft Access** :- used as a management tool to store the inventory information, distress data, treatment and cost data, and Pavement Condition Index (PCI) values.
- ❖ **Visual Basic.Net** :- used as a modeling tool to help in evaluating the city pavements condition and to provide information and decisions about the city maintenance needs, costs, and priorities.



Road Inventory

• **The data for each road section includes such information as:**

- **Section Identification**
- **construction year (last surface).**
- **Street name, and number.**
- **Beginning and ending of the section.**
- **Functional classification.**
- **Number of lanes.**
- **Pavement type**
- **length, width and area of the section.**
- **Average Daily Traffic (ADT).**

Pavement Condition Survey



- **Determines the condition of each road section based on pavement distresses (using appropriate technology)**
- **An accurate condition survey is critical in helping determine appropriate maintenance/repair strategies to restore a deteriorated pavement to an acceptable level.**
- **Visually looking for indications of distresses, including:**
 - **Cracking**
 - **Distortion**
 - **Disintegration**
 - **Drainage Problems**



Figure 8 The middle part of the monitoring screen



Figure 11 The full scale machine ready for a trial run



Figure 12 The distance travelled device

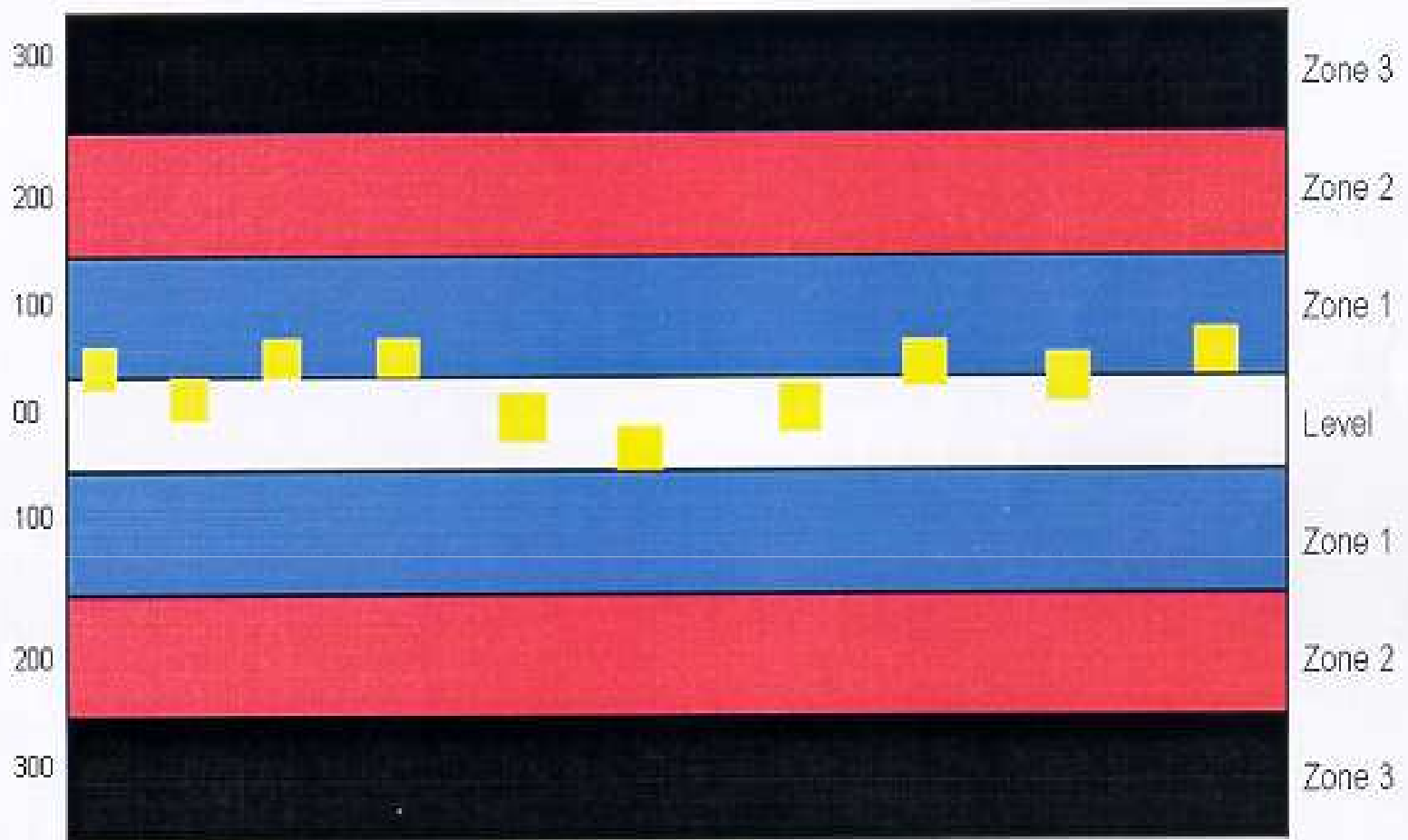


Figure 13a Road category A (section in good condition)

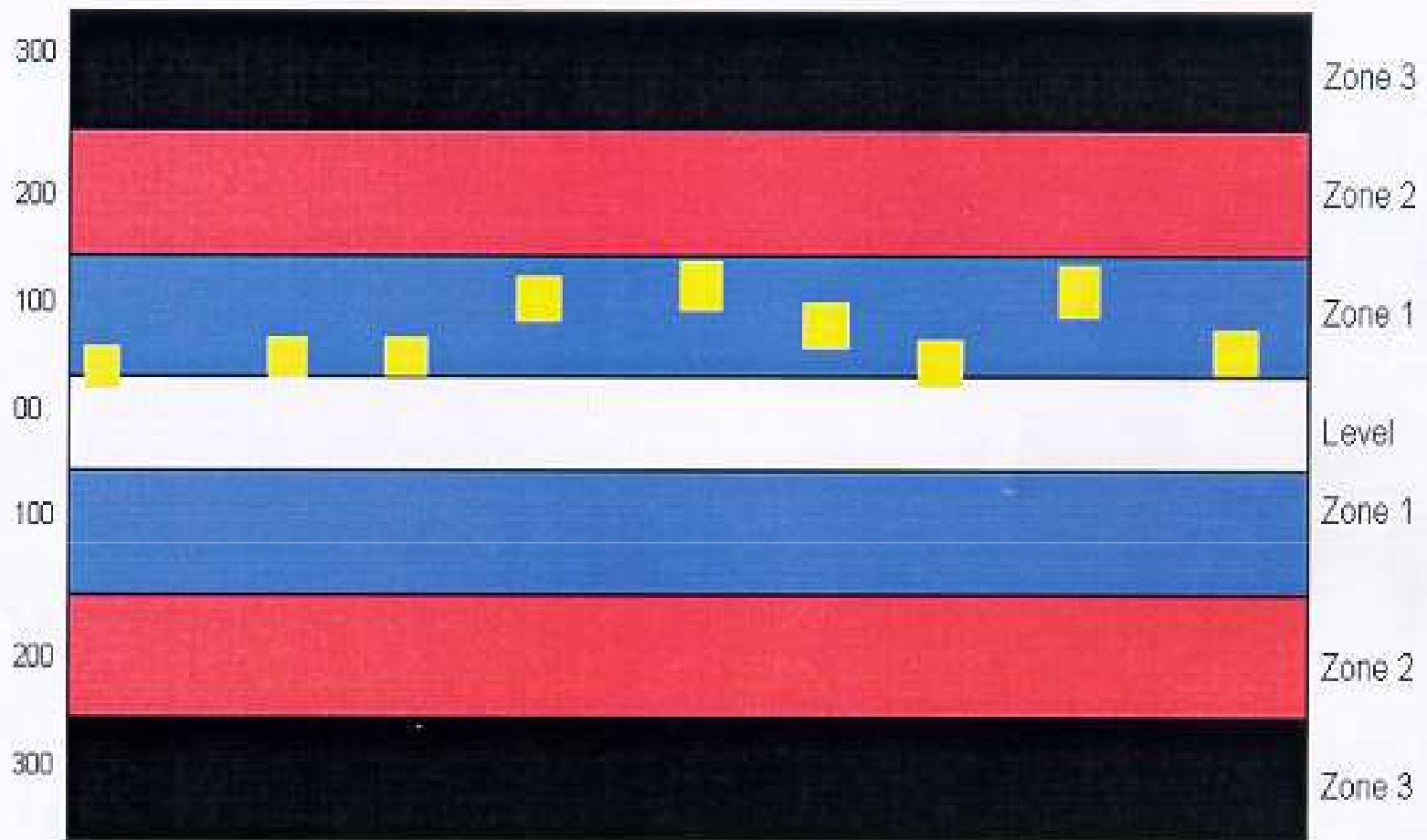


Figure 13b Road category B (section need attention soon)

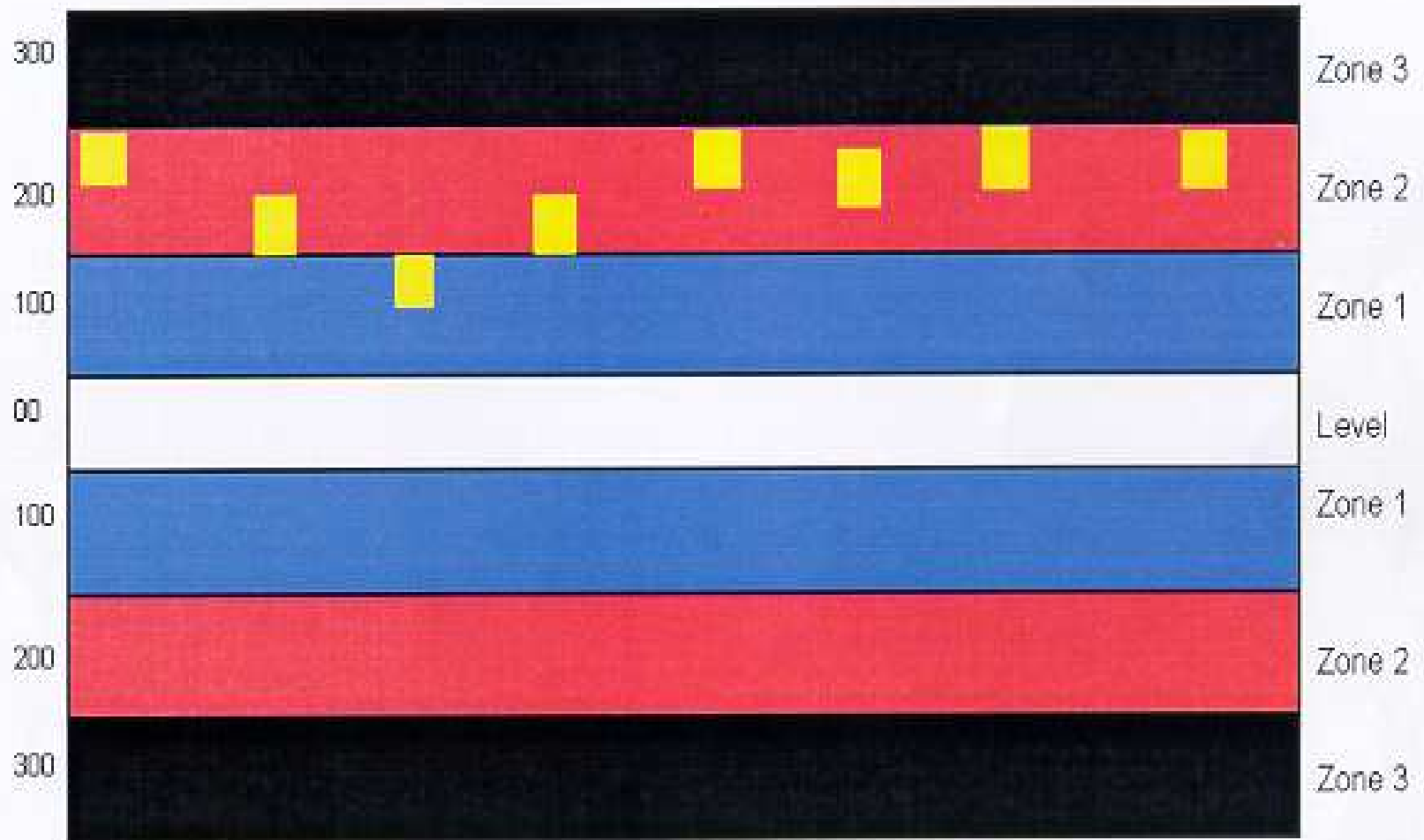
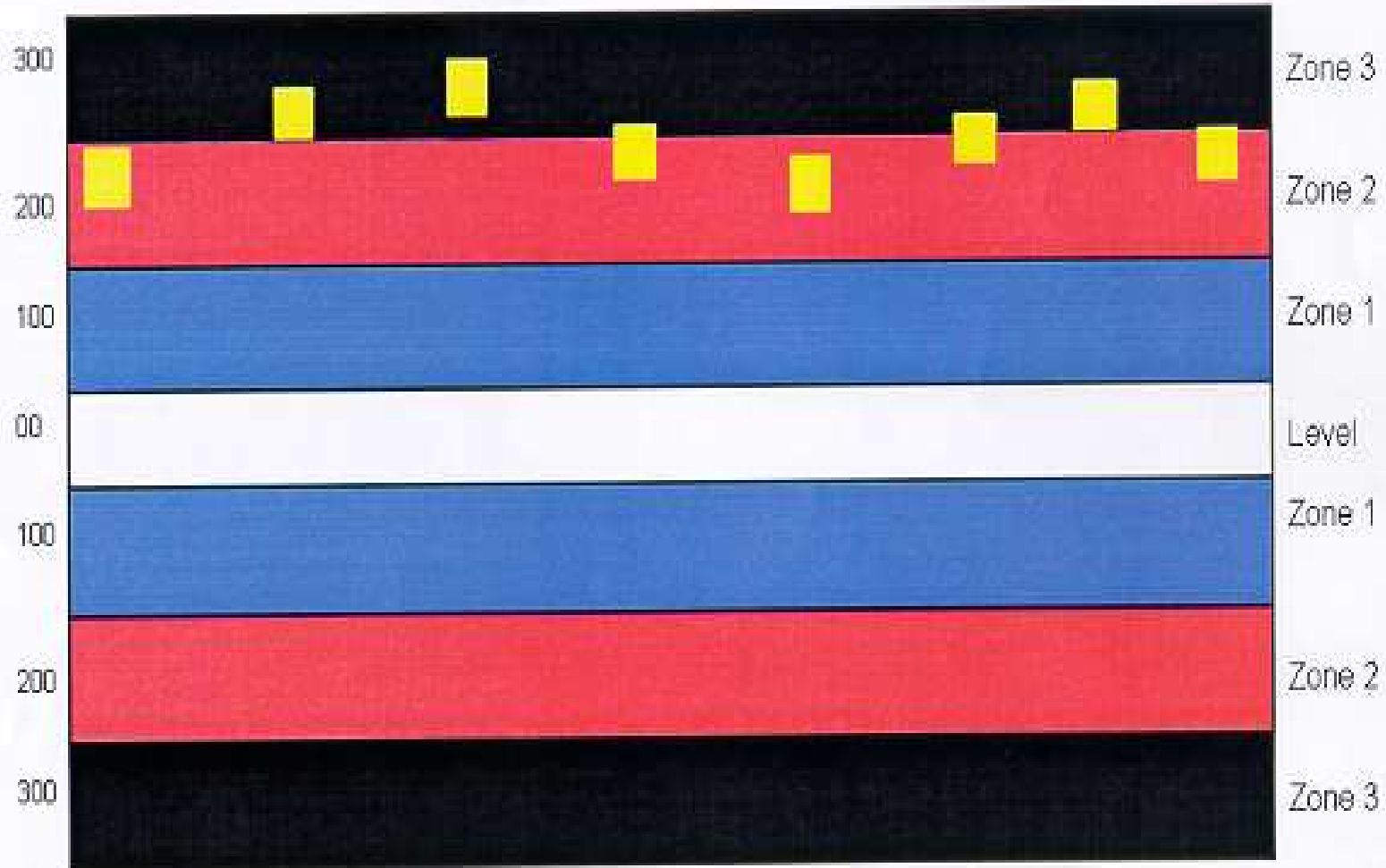
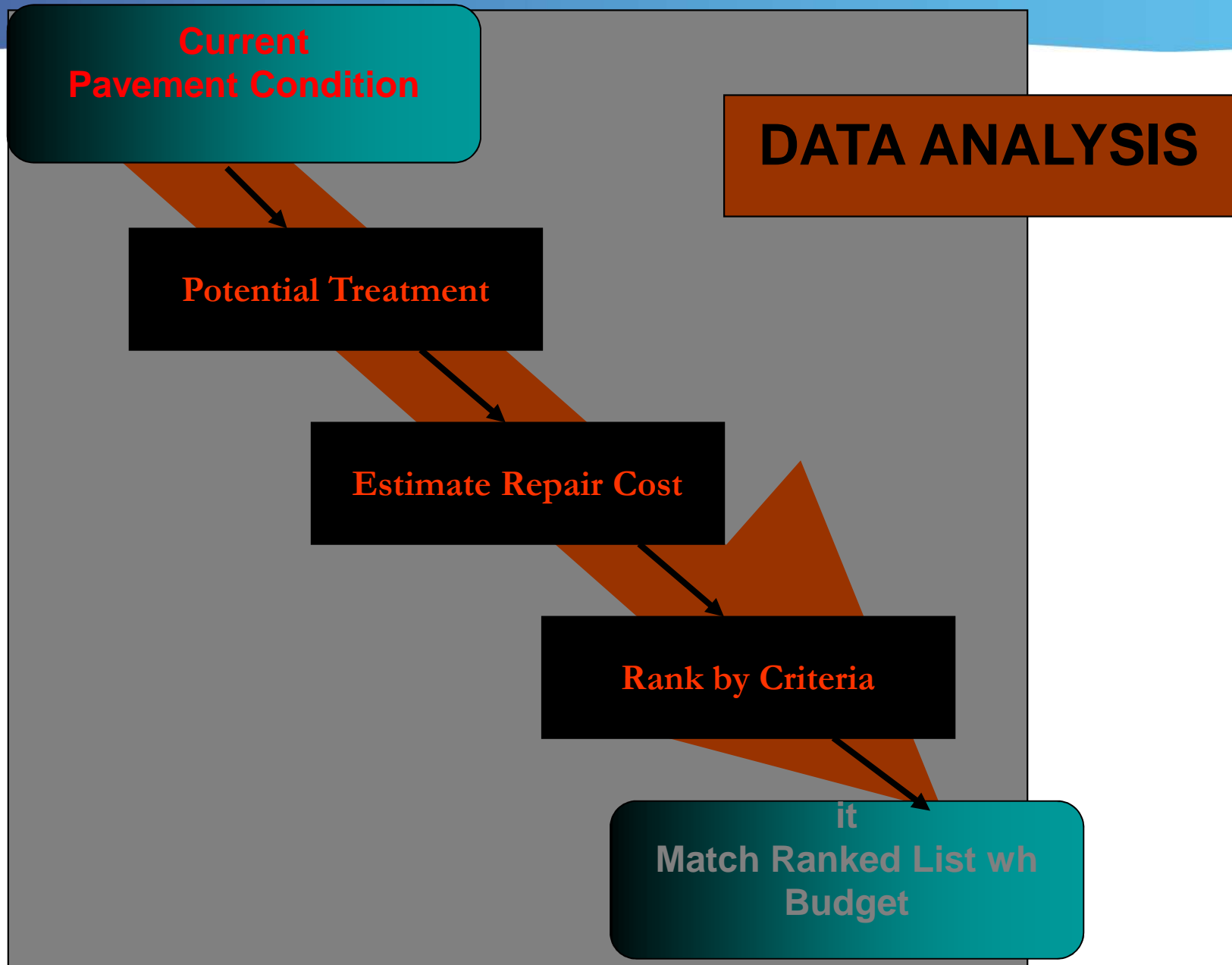


Figure 13c Road category C (section need attention now)



Road category D
Figure 13d Road category D (section completely failed)





PMMS Computer Program Organization

- 1. Inventory Data entry (Basic Operations)**
- 2. Work Information entry (Additional Field Data)**
- 3. PCI Inspections entry (Basic Operations)**
- 4. Maintenance & Repair needs and costs reports**
- 5. Priorities report**

Application of The Proposed Package in Some Real Life Cases

Arterial roads of the city network have been selected to be used as a case study for the following reasons:-

- 1. These roads have an economic and strategic importance because of the places they link.*
- 2. Arterial roads are most liable to deteriorate rapidly because they carry out the heaviest traffic loads.*
- 3. Sections of Arterial roads covered different condition categories from good to failed.*

Inventory Screen (Basic Operations)

INVENTORY DATE ✕

Road Number: Road Name:

Section ID.No: Construction Date:

From: Region:

To:

Length (m): Width (m):

Area (m²):

Functional class:

Carriageway: Single Dual

Number of carriageway lanes:

Average daily traffic:

Storm draining system:

- Drains on left
- Drains on right
- Drains on middel
- Road Lighting
- Sewage system

Type of pavement: Number of road signs:

Type of base: Number of culvert:

Footway surface type: Number of bridges:

Footway width:

Level of construction standard:

Notes:

Surveyed by:

Survey date:

Field Inspection data screen (Basic Operations)


FIELD INSPECTIONS

Road Number: 1012 Inspection Date: 2006/08/08 Edit

Road Name: Sudan Street Section ID. No.: 1012AR/003 Calculate Condition

1012AR/001 Sub section number: 1 Road surface condition: Dry
 1012AR/002 Sub section area: 4200 Inspector: Hamida
 1012AR/003 Starting chainage: 0 Ending chainage: 350

< Previous Next > New Delete Save

Picture:  Choose Remove

Distresses of carriageway

- [0] Alligator cracking
- [1] Block cracking
- [2] Longitudinal cracking
- [3] Transverse cracking
- [4] Patching and utility cut patch
- [5] Potholes
- [6] Depression
- [7] Shoving
- [8] Reflection cracks
- [9] Slippage cracks
- [10] Rutting
- [11] Asphalt bleeding
- [12] Weathering
- [13] Raveling
- [14] Polished aggregates
- [15] Bumps and sags
- [16] Corrugations
- [17] Edge cracks
- [18] Lane/shoulder drop-off
- [19] Swell

Associated Features Conditions

- [1] Road line markings: Poor
- [2] Kerbs: Poor
- [3] Side walks
- [4] Signs
- [5] Surface Drainage
- [6] Culvert
- [7] Lighting

Distress Num...	Description	Severity	Quantity	Unit
2	longitudinal cracking	Medium	145	m
0	Alligator cracking	High	46	m ²
5	Potholes	Medium	3	number
		High	1	number
		Medium	260	m ²

Distress quantity: m² Distress severity:

Assessment Results

Inspection date: 2006/08/08
 Road Name: Sudan Street
 Road number: 1012
 Section ID No.: 1012AR/003

Rating: Very poor
 PCI of section: 31

Close

Assessment result screen →

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Maintenance and Repair Needs and Costs Screen

MAINTENANCE NEEDS & COSTS

Maintenance policy: localized maintenance 71-100

Localized Maintenance

Work Type	Work Unit	Cost	
Surface Patching - AC	SQM	15.4	<input type="button" value="Edit"/>

Distress Maintenance Policies

Global Maintenance

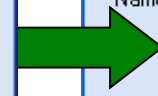
Work Type	Work Unit	Cost	
Overlay - AC Thin	SQM	3.23	<input type="button" value="Edit"/>

Structural improvement

Work Type	Work Unit	Cost	
Base Repair & Repave	SQM	35.9	<input type="button" value="Edit"/>

Reconstruction

Work Type	Work Unit	Cost	
Complete Reconstruction - AC	SQM	46	<input type="button" value="Edit"/>



LOCALIZED MAINTENANCE

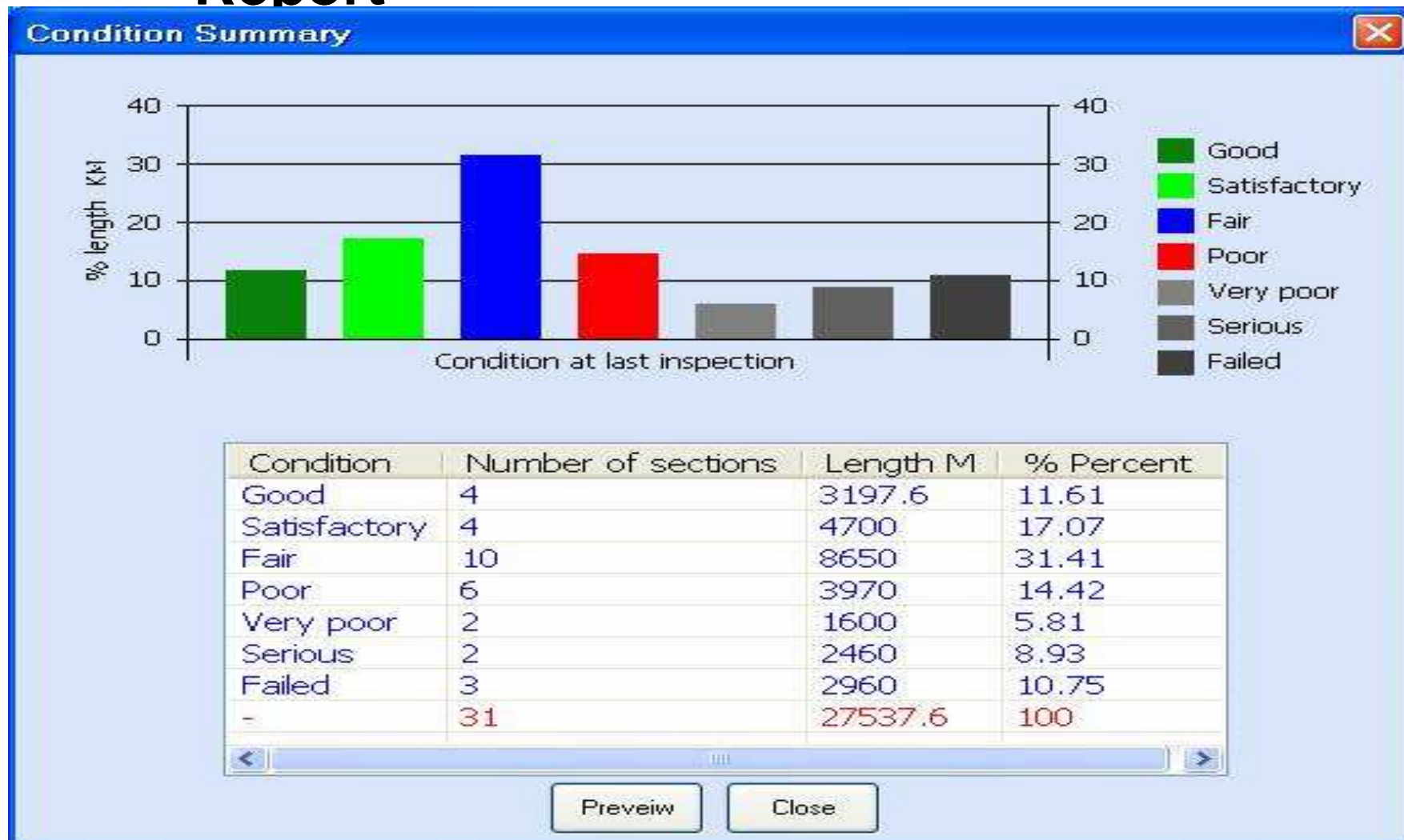
Code: D-PA Unit: SQM

Name: Deep Patching - AC Cost: 41.1

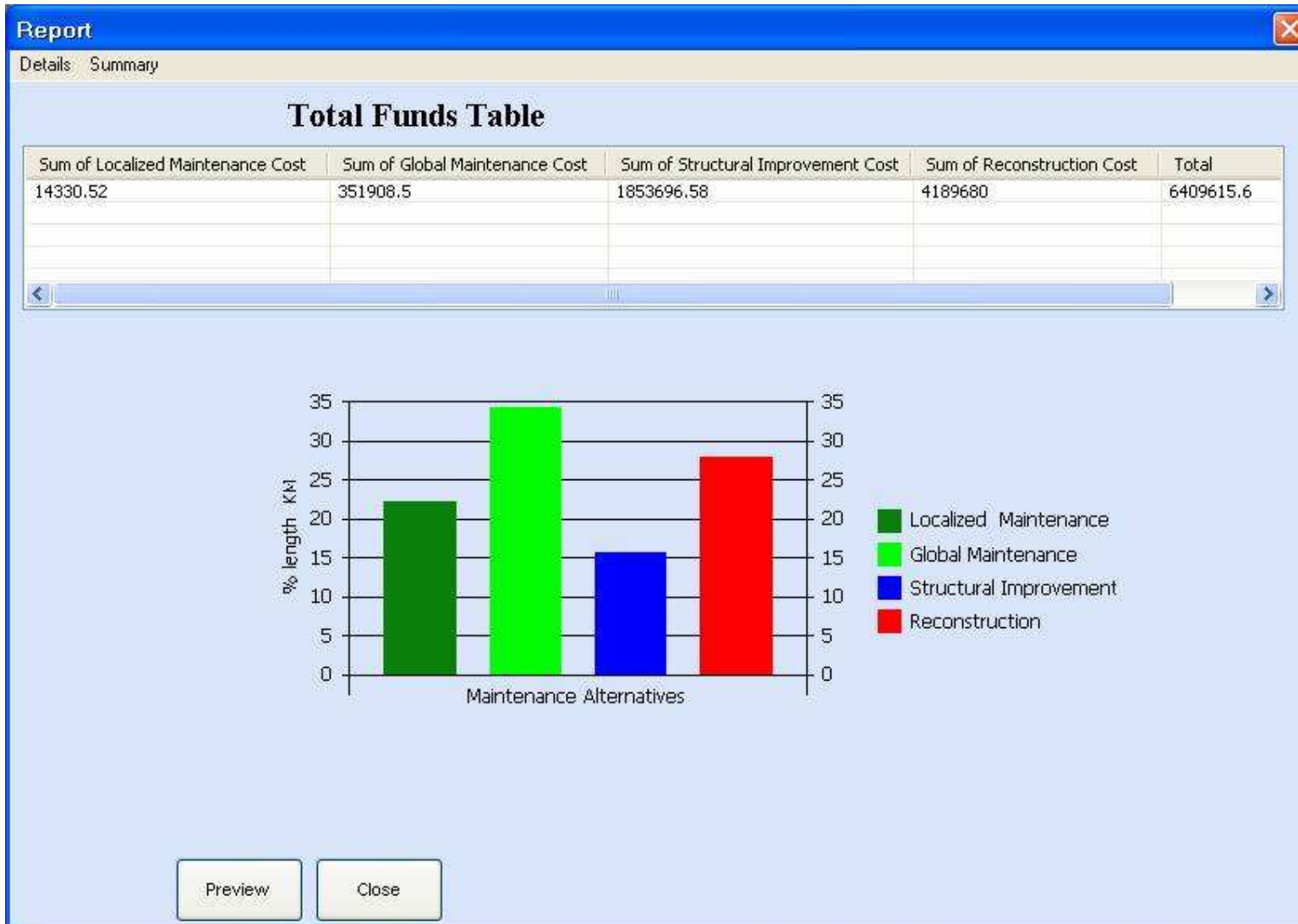
Code	Name	Cost	Unit
CS-AC	Crack Sealing - AC	1.9	M
D-PA	Deep Patching - AC	41.1	SQM
JS-LC	Joint Seal (Localized)	3.28	M
PE-RSH	Patch road edge and repair shoulder	5	SQM
SH-LE	Shoulder leveling	3.28	M
S-PA	Surface Patching - AC	15.4	SQM

PMMS Computer Program Outputs

1. Current Condition Summary Report



5. Total Funded Report





Recommendations

- ❖ **The comprehensive highway maintenance management system must be established to protect the network from rapid deterioration.**

- ❖ **The budget required for maintenance activities should be sufficient to cover all works.**



Recommendations (continued)

- **Keep historical maintenance records up to date.**
- **The continuous monitoring for road network condition by sophisticated equipment are needed to make effective maintenance decision.**



Recommendations (continued)

- ❖ **There is a great need of long-term commitment of officials, pavement managers, public and road users towards the conservation and protection of pavement assets.**

- ❖ **Future developments including a simple performance model to predict pavement condition for road network should be considered.**