

STRATEGIC AND ECONOMIC CONSIDERATIONS FOR PAVEMENT TYPE SELECTION

By J C van der Walt

ACKNOWLEDGEMENTS

Paper by M F Mitchell and R N Walker

“The Economics of Pavement Type Selection”

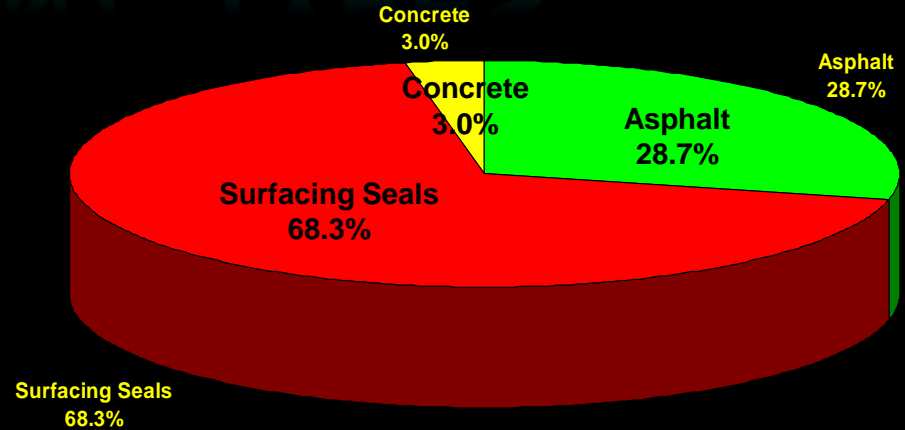
WHAT IS THE AIM OF PAVEMENT TYPE SELECTION?

**To select the most suitable type of pavement for the
given condition within the available budget**

PAVEMENT TYPES

- **FLEXIBLE PAVEMENTS (97%)**

- Granular bases (wet & dry)
- Hot mix asphalt bases
- Cemented bases
- Water bound macadam bases



- **SEMI RIGID / COMPOSITE PAVEMENTS**

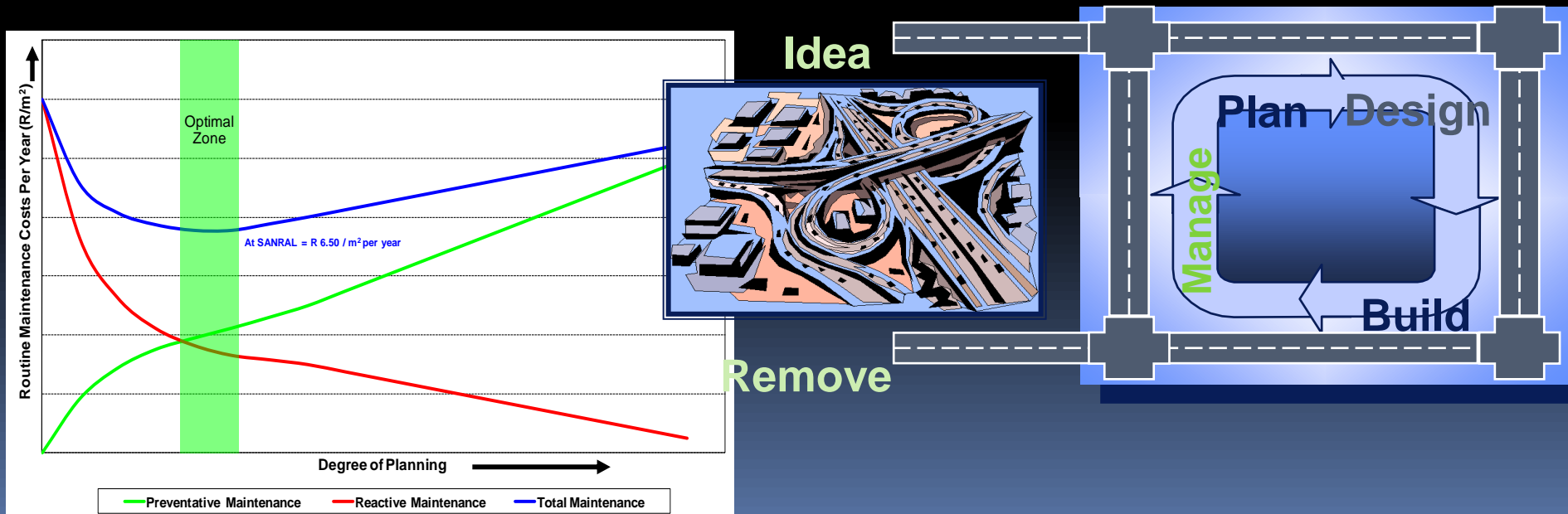
- Block paving

- **RIGID PAVEMENTS (3%)**

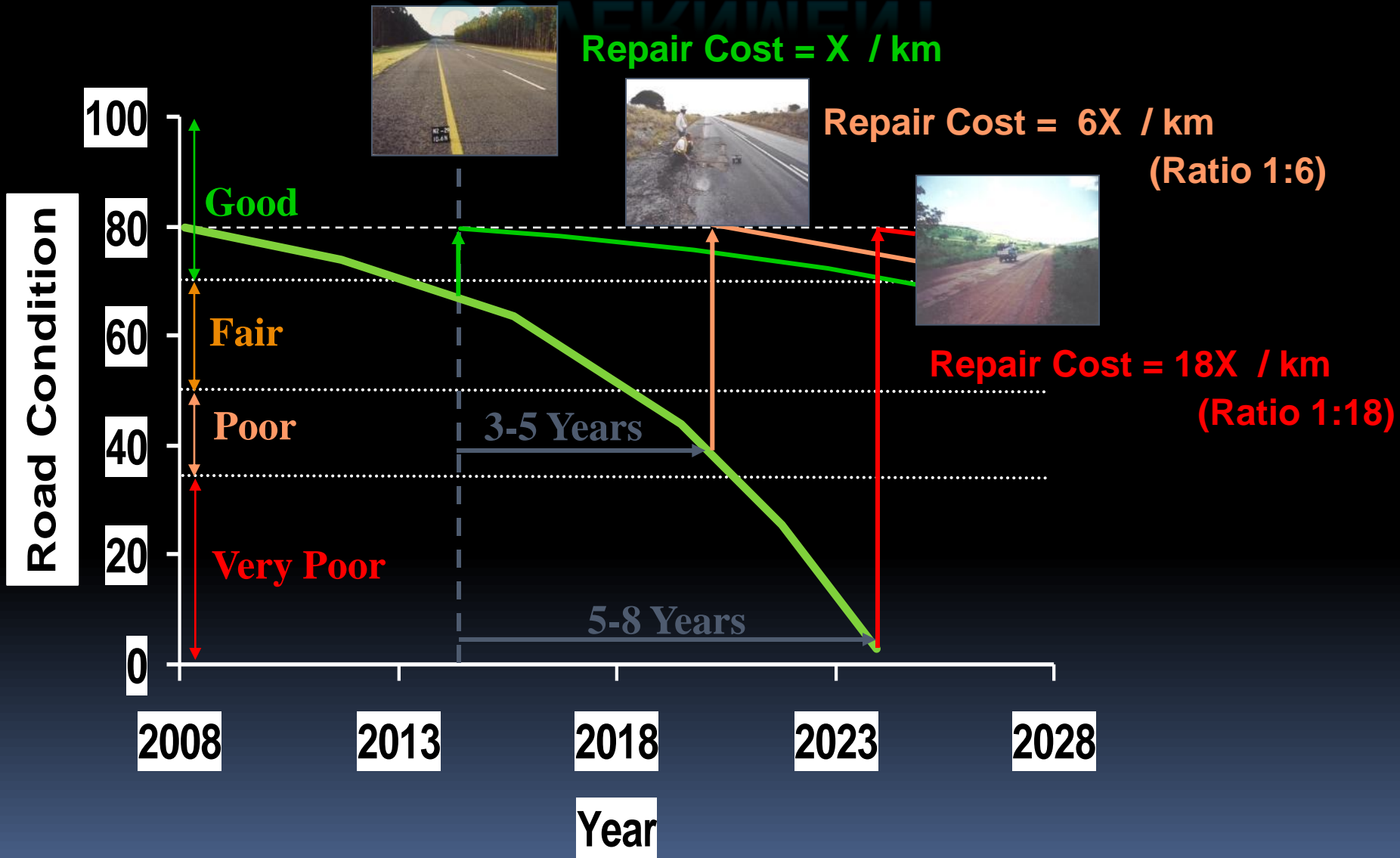
- Jointed Concrete Pavements (JCP)
- Continuously Reinforced Concrete Pavements (CRCP)
- Ultra Thin Continuously Reinforced Concrete Pavements (UCRCP)

STRATEGIC PLANNING

- Need to know the condition of your network
- Need to have asset management system in place
- Do preventative maintenance with priority on routine road maintenance and periodic maintenance
- To have a Life Cycle Strategy (LCS) for every road section / project

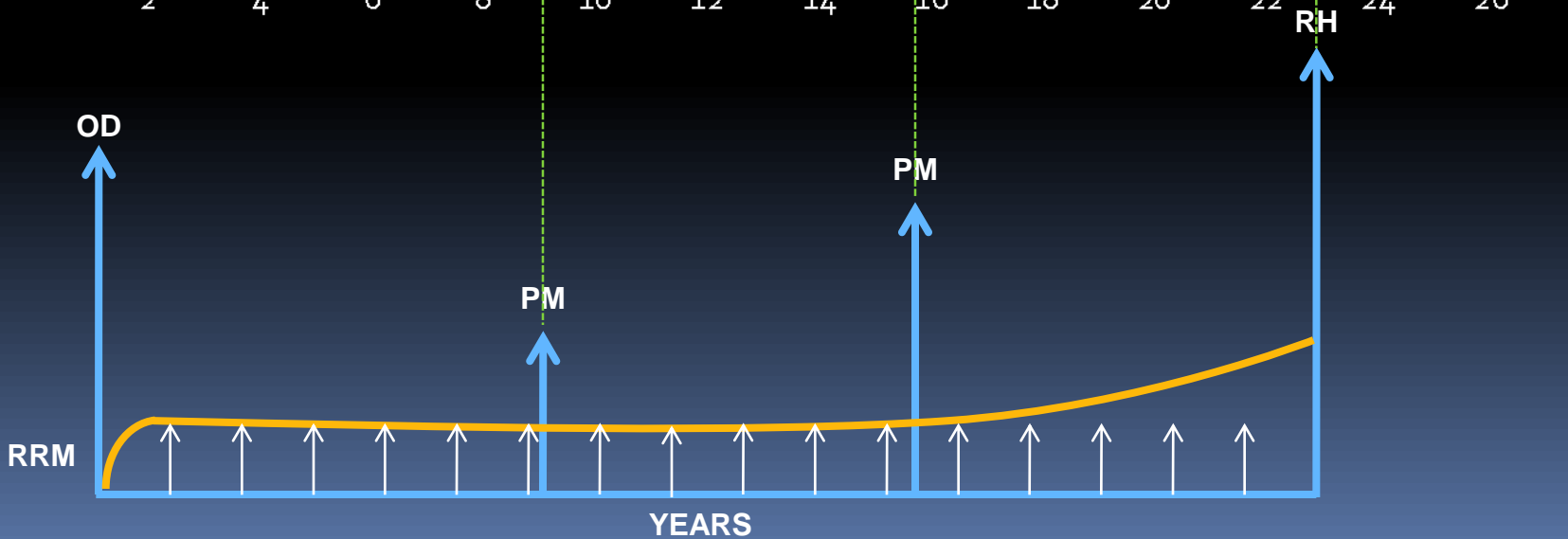
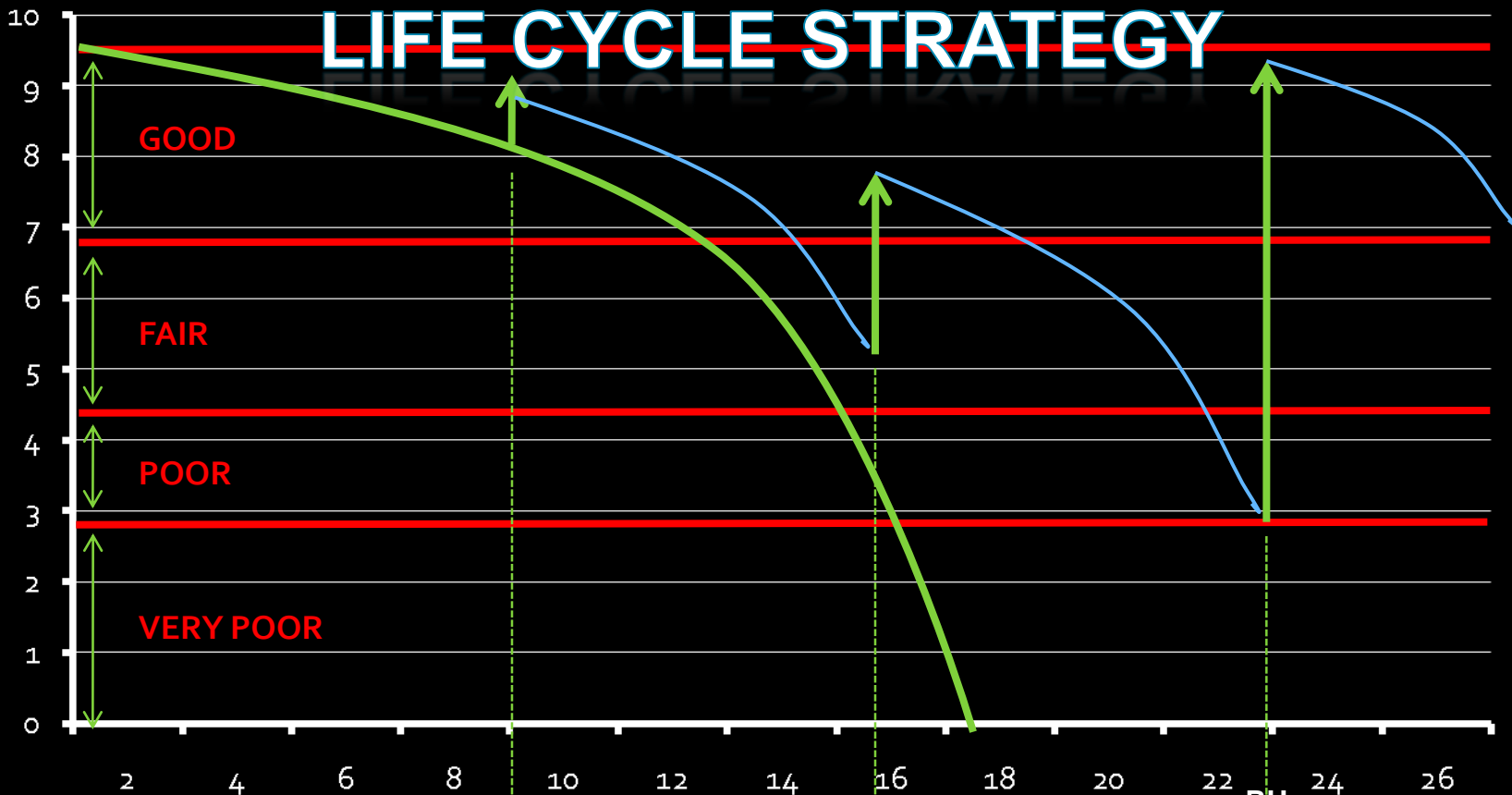


WHAT IS THE PRICE WE PAY - GOVERNMENT



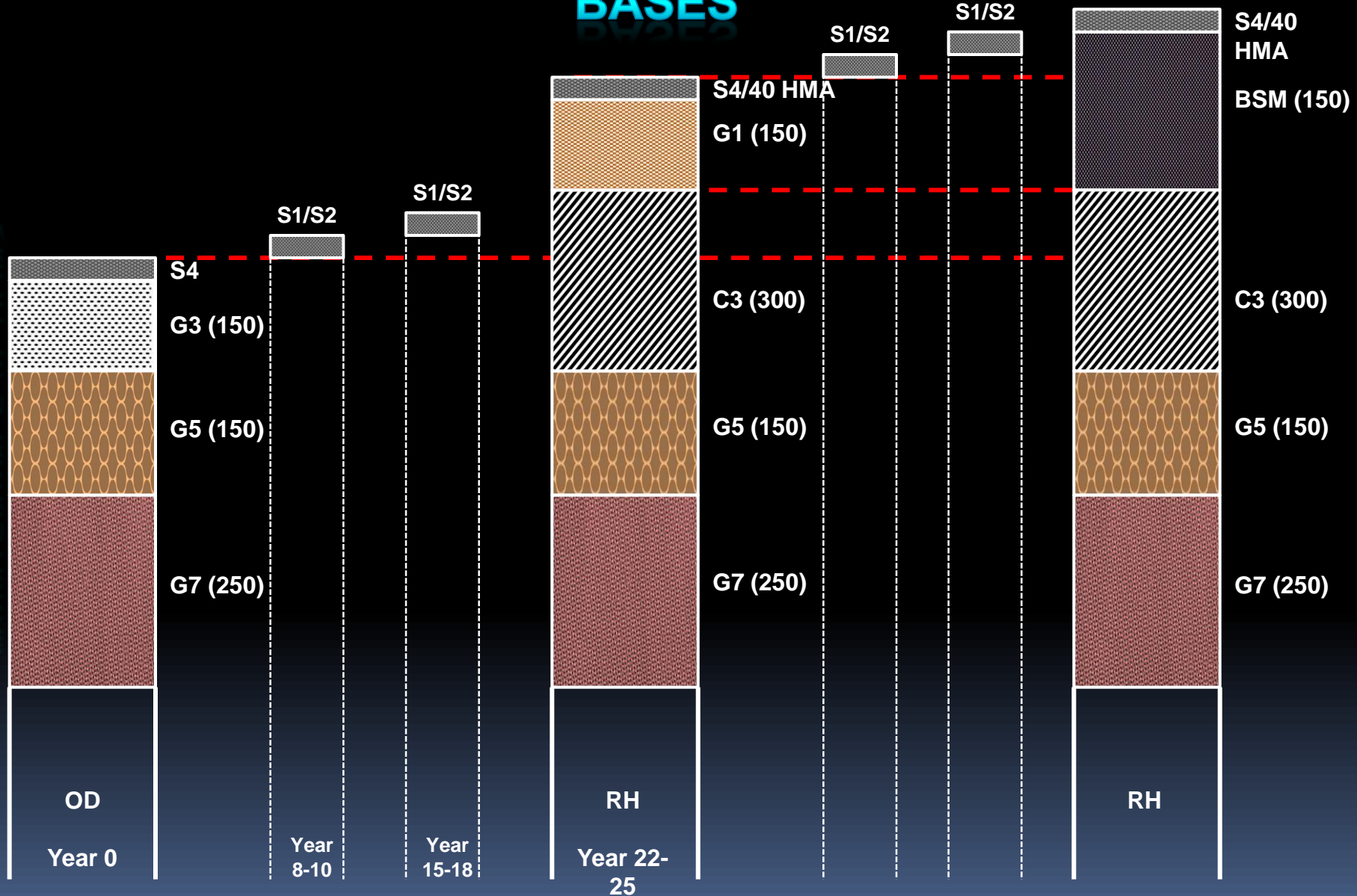
Please Note: Typical Costs for 11.4m Wide Road in Flat Terrain

LIFE CYCLE STRATEGY



EXAMPLE OF LIFE CYCLE STRATEGY FOR GRANULAR BASES

MAINTENANCE ACTIONS

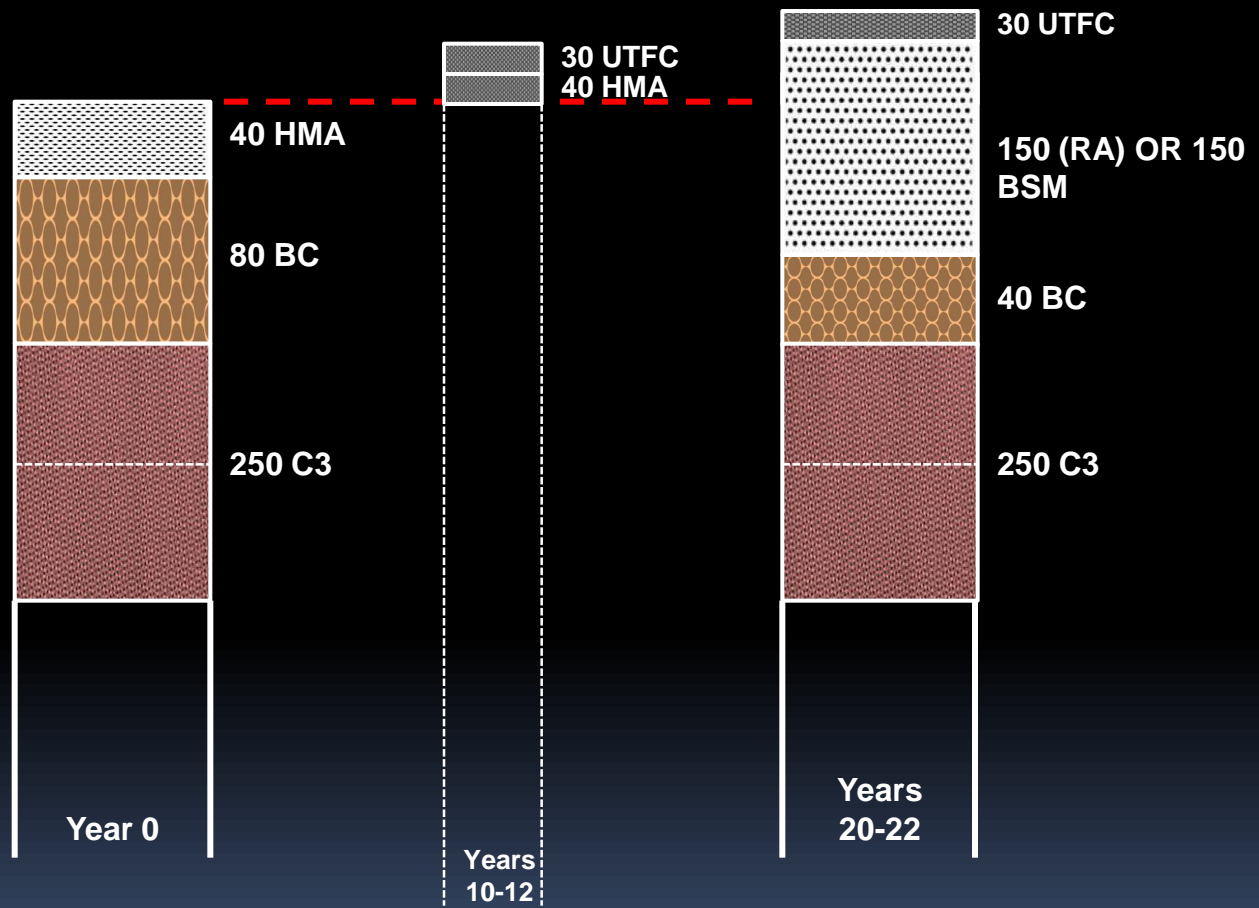


TIME / TRAFFIC



EXAMPLE OF LIFE CYCLE STRATEGY FOR HOT MIX ASPHALT BASE

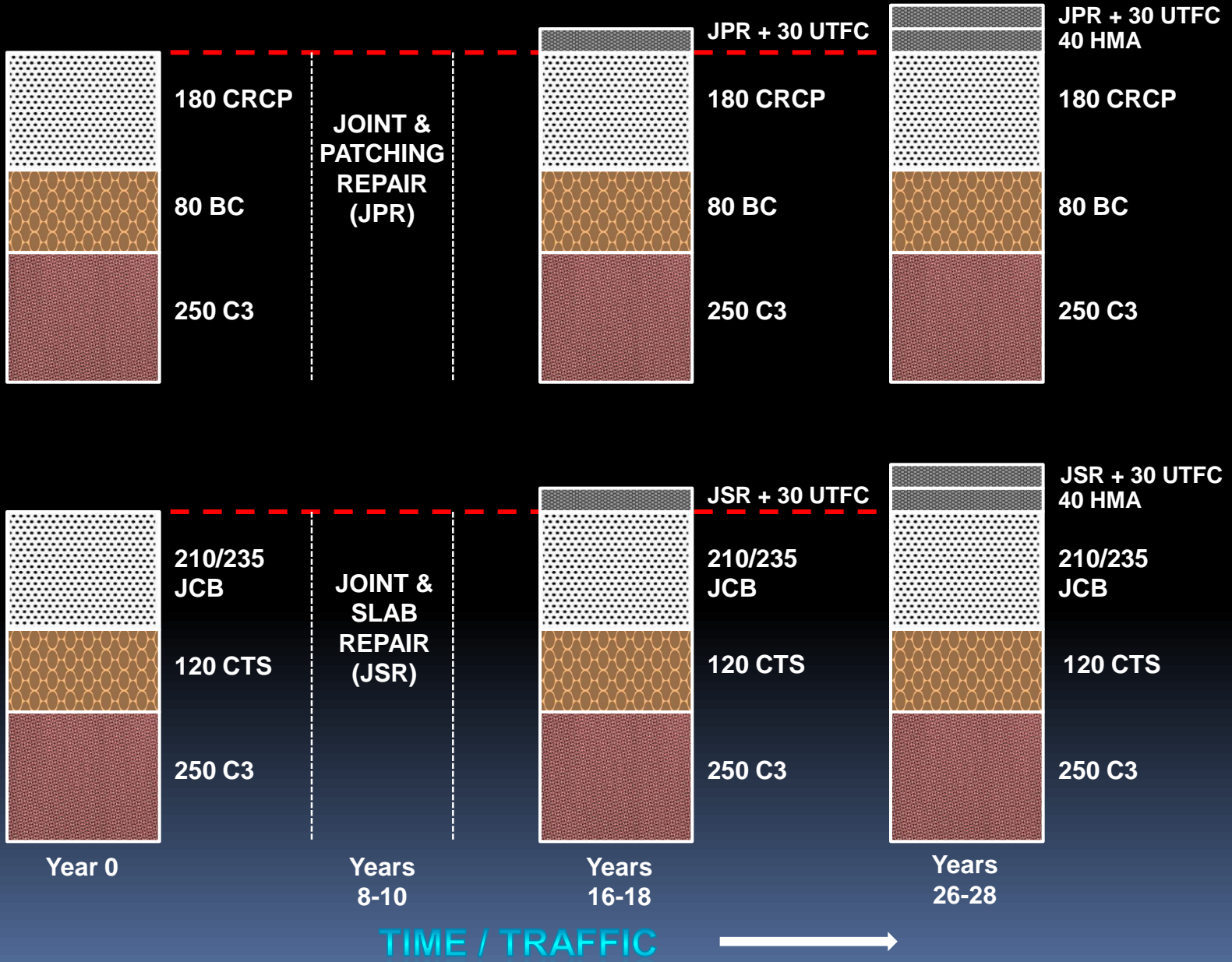
MAINTENANCE ACTIONS



TIME / TRAFFIC →

EXAMPLE OF LIFE CYCLE STRATEGY FOR RIGID PAVEMENT

MAINTENANCE ACTIONS

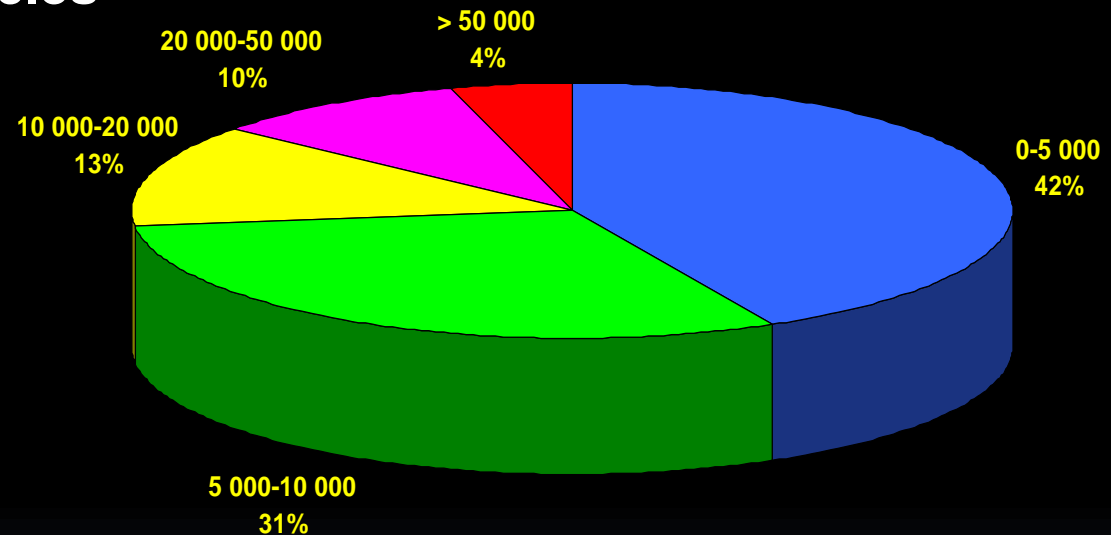


DESIGN CONSIDERATIONS

TRAFFIC

- Number of heavy vehicles
- Axle loads
- Equivalency factors
- Tyre pressures
- Wander across width
- Light vehicles
- Diversions of traffic from other routes in the same corridor
- Future land use planning

AADT on National Roads



DESIGN CONSIDERATIONS

ROAD CATEGORY: A TO D

ROAD CATEGORY (TRH 4)				
	A	B	C	D
Description	Major interurban freeways and major rural roads	Interurban collectors and rural roads	Lightly trafficked rural roads, strategic roads	Rural access roads
Importance	Very important	Important	Less important	Less important
Service level	Very high level of service	High level of service	Moderate level of service	Moderate to low level of service

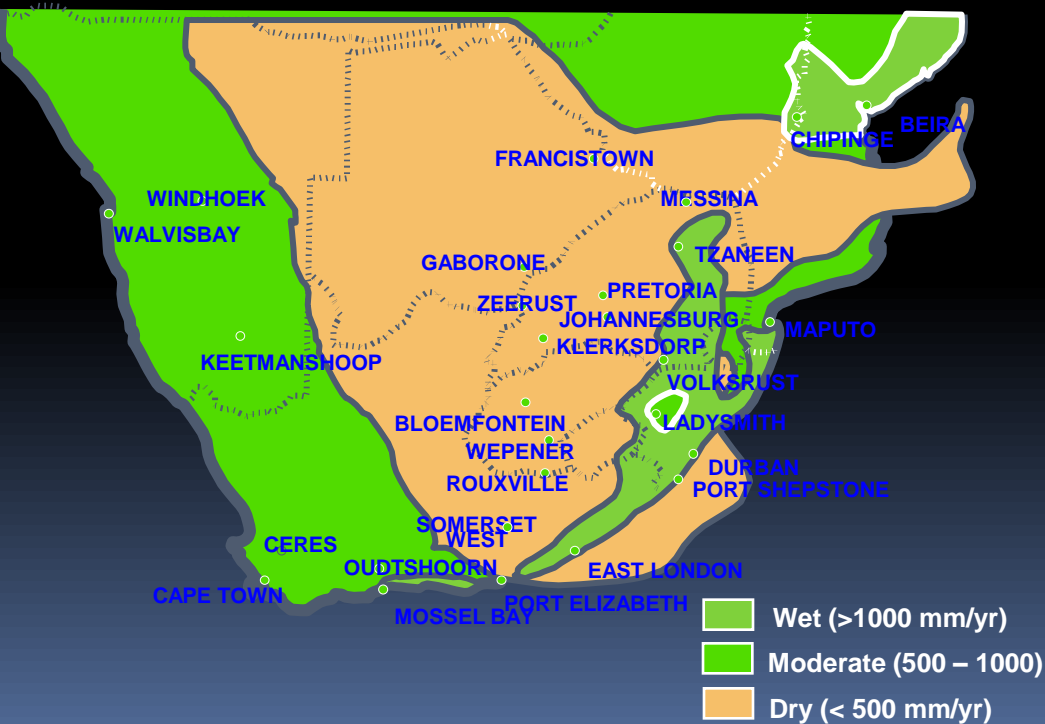
TYPICAL PAVEMENT CHARACTERISTICS				
	RISK			
	Very low	Low	Medium	High
Approximate Design Reliability (%)	95	90	80	50
Total Equivalent Traffic Loading (E80/lane)	3-100 x 10 ⁶ over 20 years	0.3-10 x 10 ⁶ Depending on design strategy	< 3 x 10 ⁶ Depending on design strategy	< 1 x 10 ⁶ Depending on design strategy
Typical Pavement Class	ES8-ES10	ES6-ES8	ES1-ES7	ES1-ES6
Daily Traffic: (e.v.u)	> 4000	600-10 000	< 600	< 500

DESIGN CONSIDERATIONS

CLIMATE

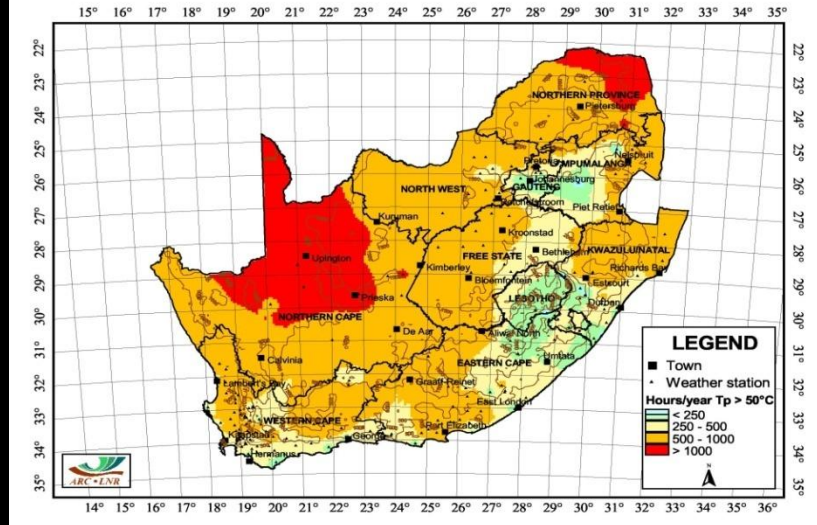
- Min & Max Temperatures
- Rainfall

Rainfall zones



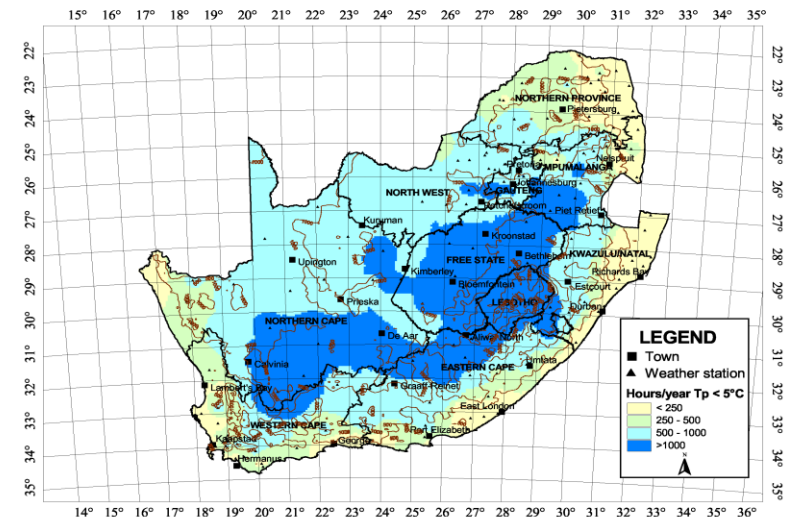
High Temperature zones

Estimated hours per year with asphalt surface temperatures above 50°C



Low Temperature zones

Estimated hours per year with asphalt surface temperatures below 5°C

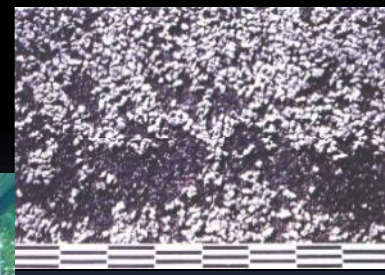


DESIGN CONSIDERATIONS

LATEST PAVEMENT DATA

Various condition parameters collected using SANRAL Road Survey Vehicle:

- **Roughness** – how bumpy is the road – speed, wear, etc
- **Rut Depth** – how much water pond on surface - safety
- **Macro Texture** – assist vehicle tire to drain water – safety, noise
- **Cracking** – how much water will get in - deterioration
- **Alignment (DGPS)** – Speed, Fuel Consumption, etc
- **ROW Video** – Road Signs, Section Measurements, etc
- Annual Surveys at 100 km/h



DESIGN CONSIDERATIONS

LATEST PAVEMENT DATA



Roughness
Rut Depth
Macro Texture
Cracking
Ravelling
Video



Surface Friction



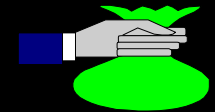
Structural Strength



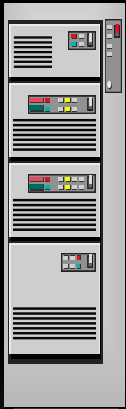
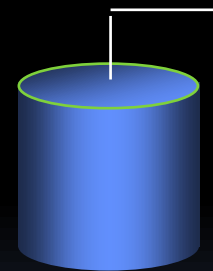
Traffic



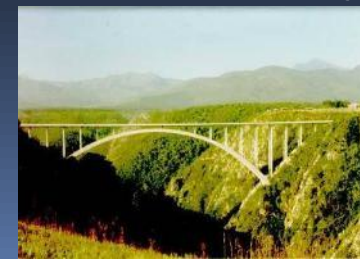
DGPS



Unit Costs



Centralised Database



Bridge

DESIGN CONSIDERATIONS

■ MATERIAL AVAILABILITY

- **Aggregate**

- The impact of opening new borrow pits / quarries
- Type, quantity and quality of material from commercial sources
- Haul distances to site

- **Bitumen**

- Be aware of refinery maintenance plans
- Communicate your bitumen requirements for the year to industry
- Cost implication of imported bitumen

DESIGN CONSIDERATIONS

- **ENVIRONMENTAL ASPECTS**
 - **Recycling of pavement layers**
 - **Impact of noise**
 - **Impact of construction activities (dust and pollution)**
 - **Time lines for approvals**
 - EIA
 - Water licences
 - EMPs
 - Blasting permits
 - **New legislation for working in dolomite areas**

DESIGN CONSIDERATIONS

TRAFFIC ACCOMMODATION

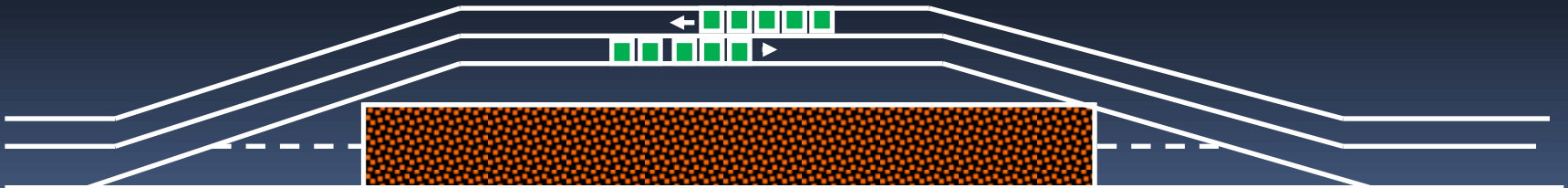
- Single lane on half-width of existing or new road (Stop/Go)



- Two lanes on half-width of existing or new road (with standard or narrow lanes)



- Two-lane gravel/surfaced deviation separated from the road under construction.



DESIGN CONSIDERATIONS

- **CONSTRUCTION**
- **PERFORMANCE OF SIMILAR PAVEMENTS IN THE AREA:**
 - **G1 does not perform well in wet areas**
 - **Asphalt does not perform well in slow lanes with steep grades**
- **RELOOK AT STANDARDS AND LEVELS OF SERVICE**
 - **How relevant is the design to specific conditions?**

NON-DESIGN CONSIDERATIONS

- **FOSTER THE DEVELOPMENT OF NEW PAVEMENT TECHNOLOGY**
 - UTCRCP
 - Agreement

- **DEVELOP NEW SMEs AND BEs**
 - Consider labour components
 - Consider ease of construction
 - Assist with purchasing of materials
 - Look at possible machine / manual combinations

NON-DESIGN CONSIDERATIONS

■ NEED TO FOSTER LOCAL INDUSTRY

- “Old NTC policy was that 20% of its pavements should be concrete and 20% of pavements to have bituminous bases”
- For technology development one needs organisations like SABITA, ASPASA (SARMA), SAFCEC AND C&CI
- **Impact of competition commission ??????**

NON-DESIGN CONSIDERATIONS

■ PLANNING

- Spread work over different regions
- Prevent site inspection and tender closures on same day
- Plan around winter embargoes
- Prevent over-saturation of market with projects
- Material availability and supply (bitumen and aggregate)
- EIA approvals and acquisition of land has long time lines

NON-DESIGN CONSIDERATIONS

■ POLITICAL NECESSITY

- Has happened but not the norm
- Normally with no interference with pavement type selection
- Service delivery very important

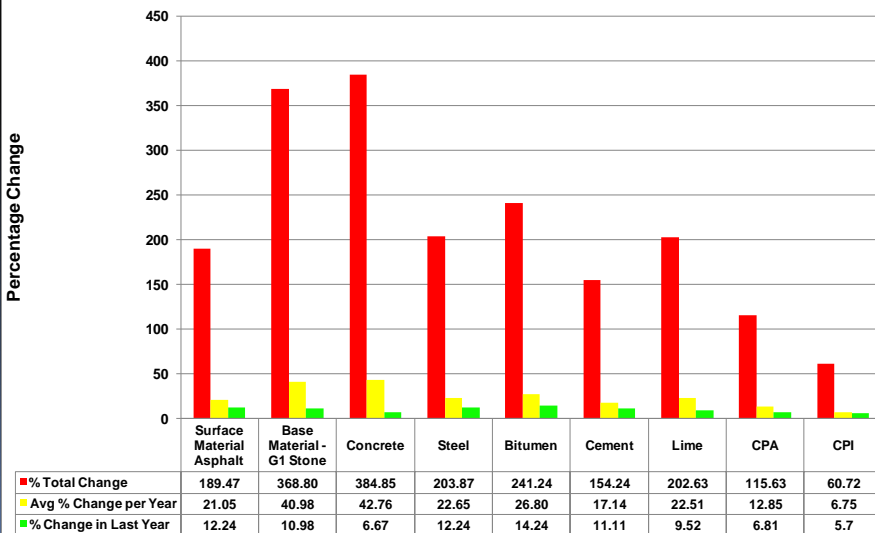


NON-DESIGN CONSIDERATIONS

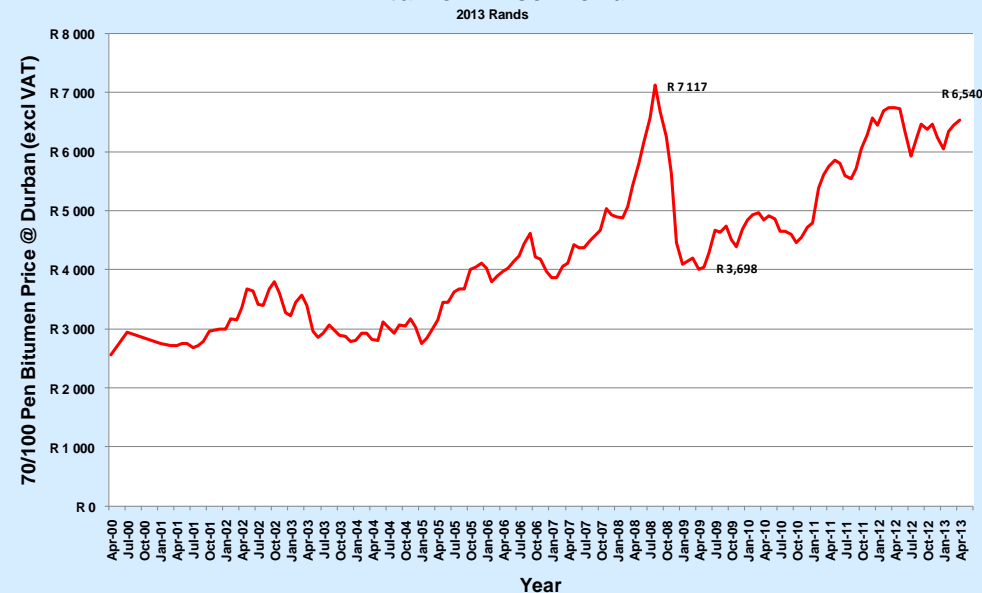
■ BUDGET:

- Availability of funds for maintenance
- Consider different pavement design options
- Materials a large component of pavement costs
- Use HDM4 for analysis (used CB Road in past)
- Manage / report project cash flows on monthly basis

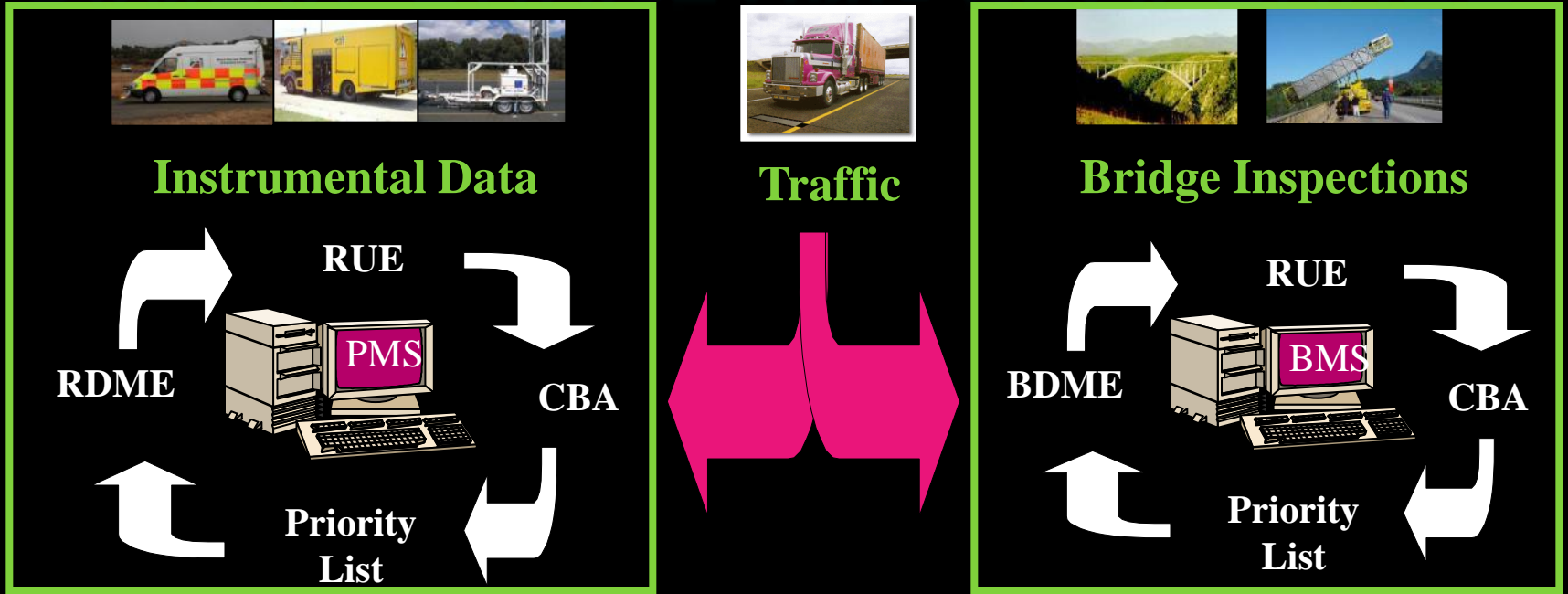
Material Cost Changes Over Period 2003 to 2012



Bitumen Price Trend



SANRAL BUDGETING PROCEDURE



Pavement Management System

Bridge Management System

Super Project List											
Project No.	Project Name	Region	Province	Start Date	End Date	Estimate	Volume	Cost	Priority	Status	Notes
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Budget Optimisation

Projected Total	Volume (B/m ³)	Estimate	Govt. Funding	Total
\$1.12	\$0.02	\$0.20	\$0.20	\$0.21
\$1.50	\$0.20	\$0.10	\$0.20	\$0.21
\$1.80	\$0.20	\$0.10	\$0.20	\$0.21
\$2.00	\$0.20	\$0.10	\$0.20	\$0.21
\$2.50	\$0.20	\$0.10	\$0.20	\$0.21
\$3.00	\$0.20	\$0.10	\$0.20	\$0.21
\$4.00	\$0.20	\$0.10	\$0.20	\$0.21
\$5.00	\$0.20	\$0.10	\$0.20	\$0.21
\$6.00	\$0.20	\$0.10	\$0.20	\$0.21
\$7.00	\$0.20	\$0.10	\$0.20	\$0.21
\$8.00	\$0.20	\$0.10	\$0.20	\$0.21
\$9.00	\$0.20	\$0.10	\$0.20	\$0.21
\$10.00	\$0.20	\$0.10	\$0.20	\$0.21
\$11.00	\$0.20	\$0.10	\$0.20	\$0.21
\$12.00	\$0.20	\$0.10	\$0.20	\$0.21
\$13.00	\$0.20	\$0.10	\$0.20	\$0.21
\$14.00	\$0.20	\$0.10	\$0.20	\$0.21
\$15.00	\$0.20	\$0.10	\$0.20	\$0.21
\$16.00	\$0.20	\$0.10	\$0.20	\$0.21
\$17.00	\$0.20	\$0.10	\$0.20	\$0.21
\$18.00	\$0.20	\$0.10	\$0.20	\$0.21
\$19.00	\$0.20	\$0.10	\$0.20	\$0.21
\$20.00	\$0.20	\$0.10	\$0.20	\$0.21
\$21.00	\$0.20	\$0.10	\$0.20	\$0.21
\$22.00	\$0.20	\$0.10	\$0.20	\$0.21
\$23.00	\$0.20	\$0.10	\$0.20	\$0.21
\$24.00	\$0.20	\$0.10	\$0.20	\$0.21
\$25.00	\$0.20	\$0.10	\$0.20	\$0.21
\$26.00	\$0.20	\$0.10	\$0.20	\$0.21
\$27.00	\$0.20	\$0.10	\$0.20	\$0.21
\$28.00	\$0.20	\$0.10	\$0.20	\$0.21
\$29.00	\$0.20	\$0.10	\$0.20	\$0.21
\$30.00	\$0.20	\$0.10	\$0.20	\$0.21
\$31.00	\$0.20	\$0.10	\$0.20	\$0.21
\$32.00	\$0.20	\$0.10	\$0.20	\$0.21
\$33.00	\$0.20	\$0.10	\$0.20	\$0.21
\$34.00	\$0.20	\$0.10	\$0.20	\$0.21
\$35.00	\$0.20	\$0.10	\$0.20	\$0.21
\$36.00	\$0.20	\$0.10	\$0.20	\$0.21
\$37.00	\$0.20	\$0.10	\$0.20	\$0.21
\$38.00	\$0.20	\$0.10	\$0.20	\$0.21
\$39.00	\$0.20	\$0.10	\$0.20	\$0.21
\$40.00	\$0.20	\$0.10	\$0.20	\$0.21
\$41.00	\$0.20	\$0.10	\$0.20	\$0.21
\$42.00	\$0.20	\$0.10	\$0.20	\$0.21
\$43.00	\$0.20	\$0.10	\$0.20	\$0.21
\$44.00	\$0.20	\$0.10	\$0.20	\$0.21
\$45.00	\$0.20	\$0.10	\$0.20	\$0.21
\$46.00	\$0.20	\$0.10	\$0.20	\$0.21
\$47.00	\$0.20	\$0.10	\$0.20	\$0.21
\$48.00	\$0.20	\$0.10	\$0.20	\$0.21
\$49.00	\$0.20	\$0.10	\$0.20	\$0.21
\$50.00	\$0.20	\$0.10	\$0.20	\$0.21

Eastern

Programming

Projected Total	Volume (B/m ³)	Estimate	Govt. Funding	Total
\$1.12	\$0.02	\$0.20	\$0.20	\$0.21
\$1.50	\$0.20	\$0.10	\$0.20	\$0.21
\$1.80	\$0.20	\$0.10	\$0.20	\$0.21
\$2.00	\$0.20	\$0.10	\$0.20	\$0.21
\$2.50	\$0.20	\$0.10	\$0.20	\$0.21
\$3.00	\$0.20	\$0.10	\$0.20	\$0.21
\$4.00	\$0.20			

ECONOMIC CONSIDERATION

- **CONSIDER DIFFERENT PAVEMENT DESIGN OPTIONS**
- **USE HDM4 TO DO ANALYSE THE DESIGN OPTIONS**
- **MANAGE AND ENSURE THAT FUND ALLOCATIONS ARE SPENT**



**ACCIDENTS ARE PROHIBITED
ON THIS ROAD**

70RCC

38TF

SANRAL: TOUCHING PEOPLES LIVES

THANK YOU!

“Where a road
passes,
development
follows right on
its heels”



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