PAVEMENT MATERIALS

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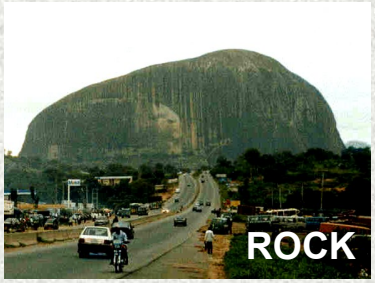


PAVEMENT MATERIALS

The Building Blocks of Road Construction

PAVEMENT MATERIALS

PRIMARY CLASSIFICATION
BY:-

PARTICLE SIZE - Grading

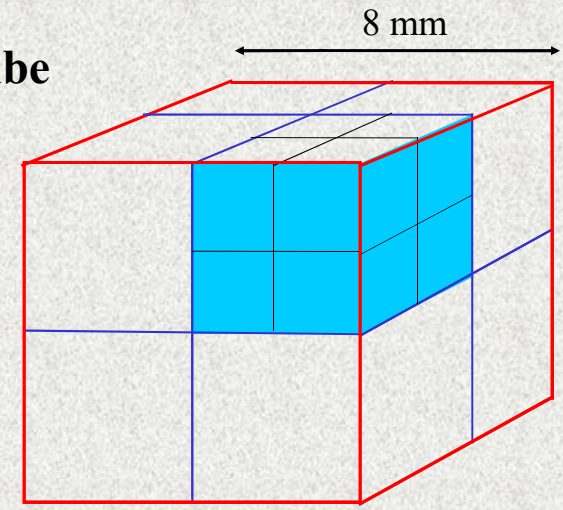
PLASTICITY - Atterberg Limits
{ "Clayeyness")

SECONDARY BY:-

STRENGTH - CBR : Unbound
ITS : Bound
10% FACT : Solid

PAVEMENT MATERIALS

8 mm Cube



1 Particle
8 mm Diam

64 Particles
2 mm Diam

PAVEMENT MATERIALS

SURFACE AREA OF PARTICLES

Consider particles in a 8 x 8 mm Cube

Description	Size	Particle No.	Surface mm^2	Area - Unit
Gravel	8 mm	1	200	1
Sand	2 mm	64	800	4
Silt	60 µm	2,37 mil	26 000	130
Clay	2 µm	64 bil	800 000	4 000

PAVEMENT MATERIALS

But what does all that mean? The larger the surface area, the more likely that the material will be sensitive to WATER.

CBR Strength vs Moisture — Surface Area

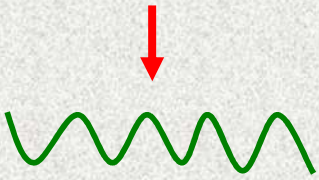
Material	Soaked	vs OMC	vs 50% OMC	
G4	80	104	200	Low
G10	3	20	67	High

Moisture: Wet → Dry

PAVEMENT MATERIALS

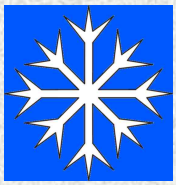
LOADING CONDITIONS

- Single (one-off) Load
- Repeated Loads



MUST RETAIN PROPERTIES (Durability)
Subjected also to Climatic 'Loading'

- Water
- Temperature



PAVEMENT MATERIALS

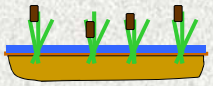
SUBGRADE = The Bottom Line!

Most Southern African Subgrades are fair to good in quality

However, there are some problem kids:-

- ✓ **Expansive Soils (Smectites - Active Clays)**
- ✓ **Soft Soils (Floodplains / Estuaries)**
- ✓ **Collapsing Soils (Granitic Sands / Dunes)**

Wet, poorly drained areas



PAVEMENT MATERIALS

You will find water seeping . . . . . through most civil engineering Failures

A. Casagrande

PAVEMENT MATERIALS

Standard South African Symbols for Pavement Layer Materials

Unbound	**G1 to G3**	**Crushed Rock**
	G4 to G6	**The Gravels**
	G7 +	**The Rest**
Bound	**C1 to C4**	**Cemented Gravel**
	BSM1 to BSM3	**Emulsion or Foam Treated**

SHORT BREAK

10 Minutes

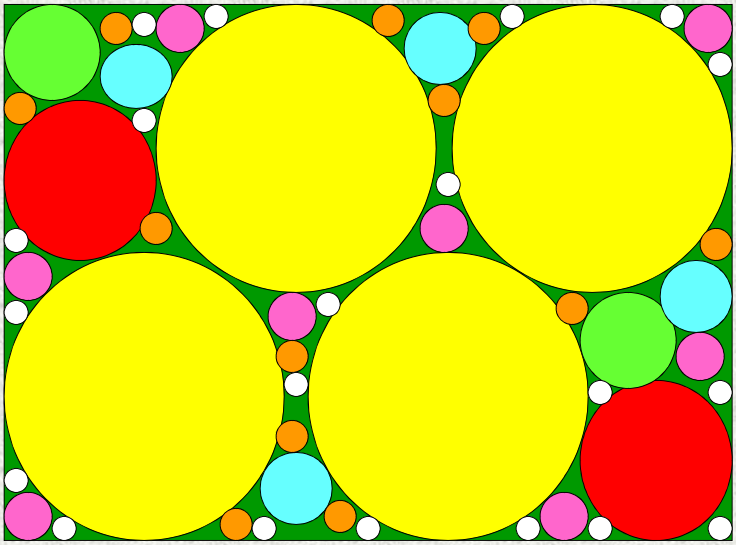
PAVEMENT MATERIALS

CONTROLS : TRH 14, COLTO & SABS

Grading – Smooth, well graded leads to:-
Good compaction (packing)
Good interlock (particle support)
Good strength and low permeability

Fuller Curves used to get maximum (densest) packing.

Plasticity – An indication of sensitivity to moisture. High PI = likely problems with strength and movement



PAVEMENT MATERIALS

STRENGTH

(G1 to G3) High Quality

Control by:- Aggregate Strength, Grading and PI.

(G4 & <) More Moderate Quality

Control by:- CBR, Grading and PI

PAVEMENT MATERIALS

DURABILITY

Weathering

Physical

&/or

Chemical

Artificial Strength

Unbound

Durability Mill (P0,425 & PI)

10% FACT (wet & dry)

Ethylene Glycol & $MgSO_4$

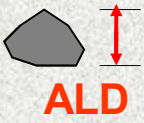
Bound

UCS

ITS

Brushing Test (wet & dry)

AGGREGATES



- **SHAPE :** Cubical → Flaky
- **GRADING :** Single Size
- **TOUGHNESS :** Polishing / Breakdown
- **STRENGTH :** Resistance to Crushing
- **DUST :** NO^2
- **ADHESION :** Particle Charge

BINDERS

Distillation

BITUMEN

Gassification

TAR *

* Carcinogenic - No longer permitted on SA Roads

BINDERS

In the normal range of ambient temperatures Bitumen is a solid.

To spray it onto the road we need to alter it's viscosity so that it becomes a fluid.

We do this in one of three ways:-

1. By Heating — Straight 'Pen' Binder
2. By Softening with a 'cutter', and then heating — Cut-back Binder
3. By Emulsifying with water — Emulsion

BINDERS

PRIME : ~~Tar~~, Cut-Back Bitumen & Emulsion.

Applications : 0,6 to 0,7 l/m^2 Residual Binder

BUT, why do we use them?

ENRICHMENT SPRAY : Diluted Emulsions & Special Rejuvenators

Applications : 0,12 to 0,5 l/m^2 Residual Binder

BINDERS

Type	Advantages	Disadvantage
Pen Bit	Cost Effective Quick to Open	Spray @ high T X in Cold/Wet
Cutback	Stays soft for several days	Cost of Cutter Unstable early
Emulsion	Spray at close to ambient T	Water adds cost espec. transport
Modified	Better props at extreme Temps	CO$T

New PG Bitumen Specification

Performance Grade (PG) (Max T X – Min T)

Based on typical maximum and minimum pavement temperatures; and severity of Traffic Conditions (X).

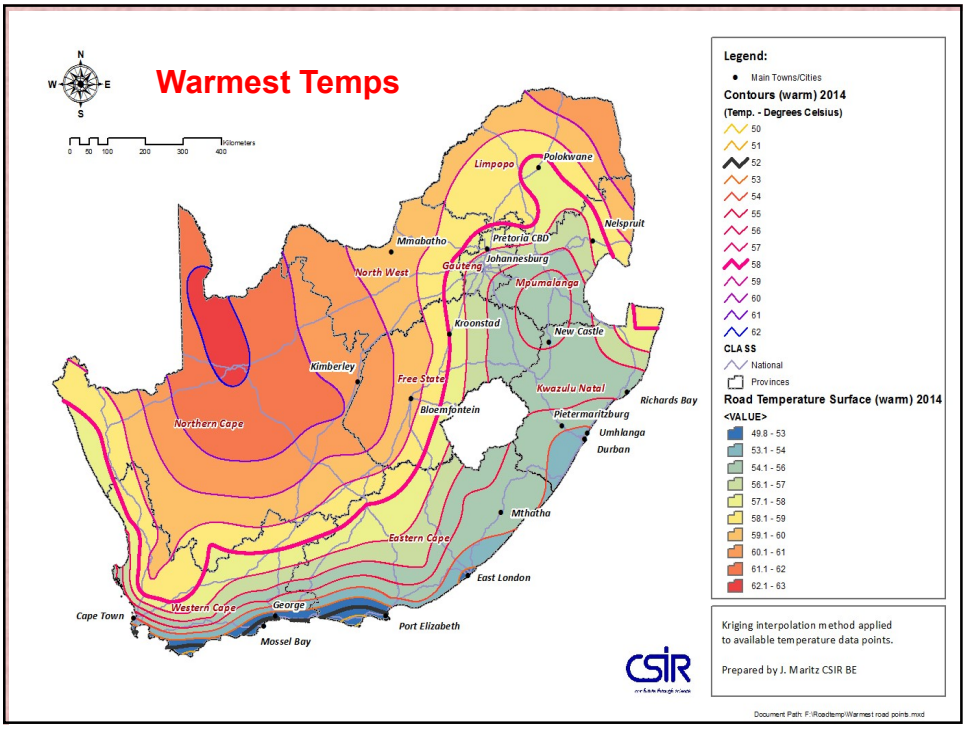
Two major grades: 58X-22 and 64X-16

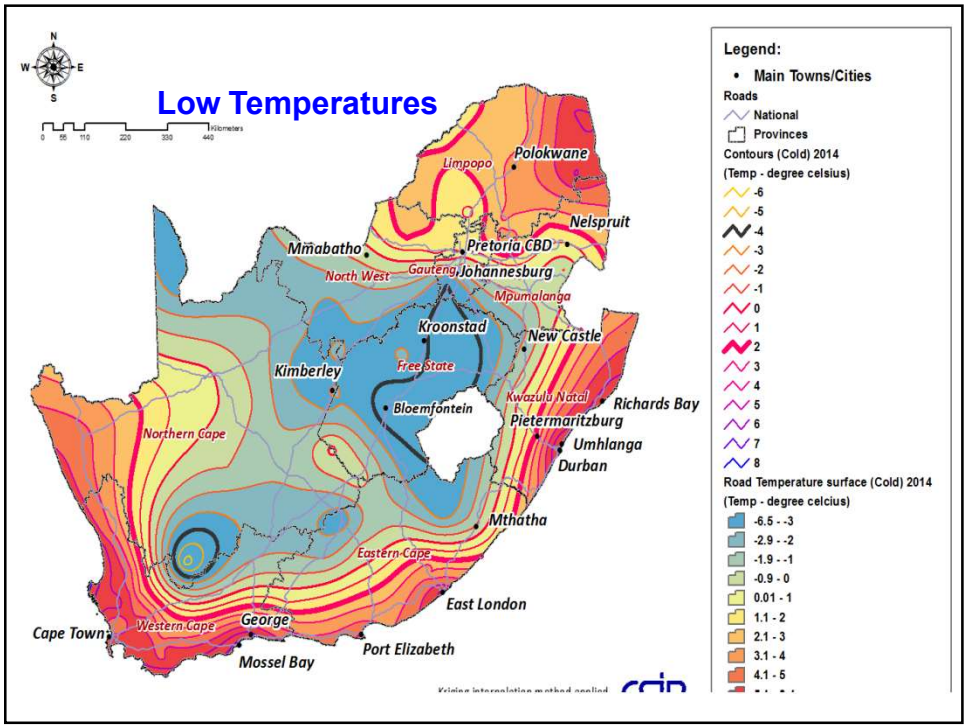
with an allowance for two hot spots 70X-10 in the Northern Cape and the Mpumalanga Lowveld.

Polymer blind.

PG Binder Grade – Traffic Categories

Cumulative E80 Axles No x 10^6	CATEGORIES		
	Speed of Travel km/h		
	< 20	20 to 80	> 80
< 0.3	S	S	S
0.3 to 3	H	S	S
3 to 10	V	H	S
10 to 30	E	V	H
> 30	E	E	V
NOTE Traffic Conditions: S = Standard, H = Heavy V = Very Heavy and E = Extremely Heavy			




Low Temperatures
N
W
E
S
0 55 110 220 330 440 Kilometers
Limpopo
Polokwane
Nelspruit
Mmabatho
Pretoria CBD
North West
Gauteng
Johannesburg
Mpumalanga
Kroonstad
New Castle
Kimberley
Free State
Kwazulu Natal
Richards Bay
Bloemfontein
Pietermaritzburg
Northern Cape
Umhlanga
Durban
Mthatha
Eastern Cape
East London
Cape Town
Western Cape
George
Port Elizabeth
Mossel Bay
Legend:
Main Towns/Cities
Roads
National
Provinces
Contours (Cold) 2014
(Temp - degree celsius)
-6
-5
-4
-3
-2
-1
0
1
2
3
4
5
6
7
8
Road Temperature surface (Cold) 2014
(Temp - degree celcius)
-6.5 - -3
-2.9 - -2
-1.9 - -1
-0.9 - 0
0.01 - 1
1.1 - 2
2.1 - 3
3.1 - 4
4.1 - 5