South African Pavement Design Method (SAPDM)

Revision Status Report

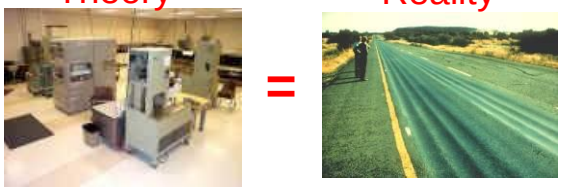
24th RPF Meeting

7 November 2012

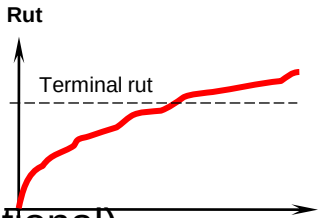
L Kannemeyer

Aka GODZILLA

SAPDM Revision - Overall Objectives



- To develop a design method that is:
  - Accurate (theory must agree with reality)
  - Enable input of basic material properties (i.e. grading, moisture content, etc) that is readily available to the user
  - Relay on results of test equipment generally available in practice
  - Must take full cognisance of the in-service operating conditions of the pavement and the impact thereof on the design inputs
  - Impartial in terms of pavement type selection
    - Unbound (Crushed stone, natural gravel)
    - Stabilised (Cement, Foamed-bitumen, Emulsified-bitumen)
    - HMA
    - Concrete / Block Paving

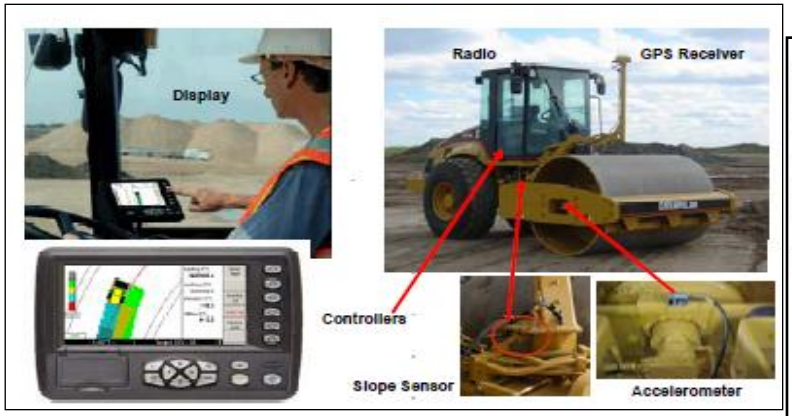


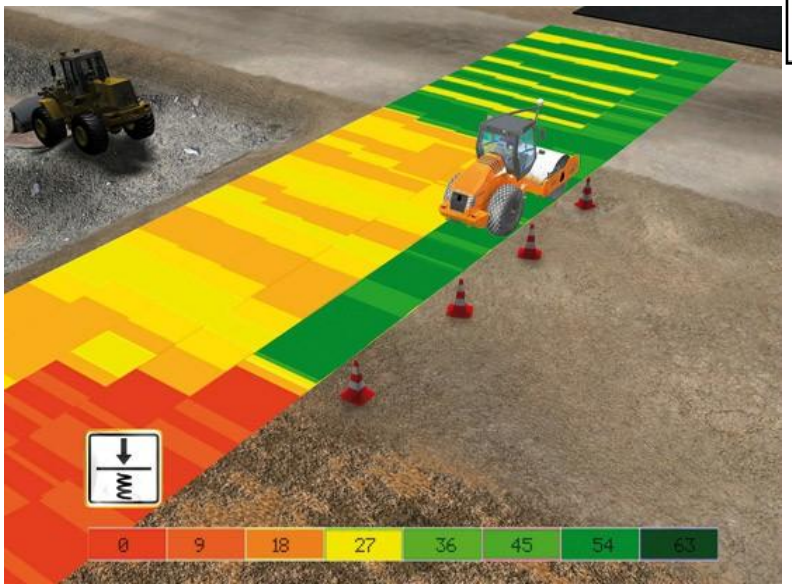
  - Incremental life cycle performance simulation (structural/functional)
  - Comprehensive cost-benefit analysis procedure assessing different life-cycle strategies and including cost and benefits for road users as well as road authorities
  - Be easy to use and allow for different levels of analysis

Introduce New Concepts/Technologies

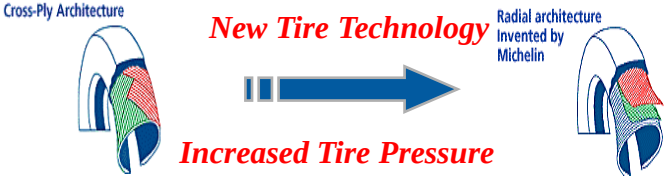
New Test Equipment

Intelligent Compaction

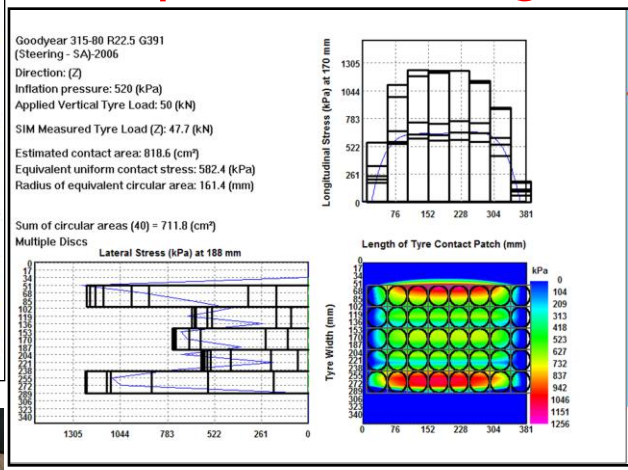




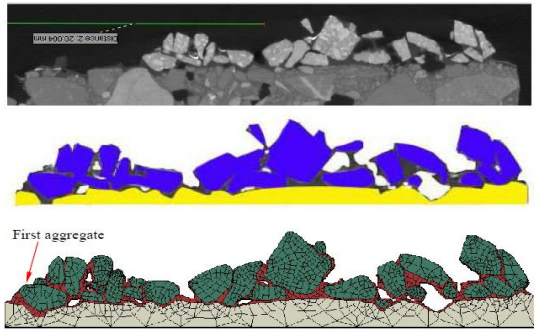
New Tire Technology



Square Loading



ME Seal Design



SAPDM Revision - Historical Overview

- Process initiated at RPF -May 2005
- R&R framework - November 2005
- Pavement Performance Information System (LTPP)
  - Material Classification Concept
  - Pavement Number Concept (PN)
  - 50 Projects Completed – February 2008
  - 11 Stabilized Projects Added – February 2008
- Mechanistic-Empirical Analysis System (MEAS)
  - Phase 1 – Develop Detailed Project Briefs – November 2006
  - Phase 2 - Inception Phase (22 Projects) – July 2007
  - Peer Review – Phase 2 Reports – November 2007
  - Additional SANRAL Requirements – December 2007
  - Appointment of Main Service Providers – **September 2008 (5 year)**
    - CSIR Built Environment
    - Pavement Modelling Corporation
    - SC Van As Traffic Engineering
- SAPDM Website (www.sapdm.co.za) – May 2009

SAPDM Revision - Progress To Date

Reports

- Nov 2009 = 8 Reports
- May 2010 = 21 Reports
- Nov 2010 = 30 Reports
- May 2011 = 43 Reports
- Nov 2011 = 56 Reports
- Nov 2012 = 77 Reports

Field Trials – Ongoing

- Environmental Nov 2012 = 41 Sites / 39 Sites
- Material Bulk Samples Nov 2012 = 3
- Experimental Sections
  - R35 Stabilisation (CTB,FTB,ETB/G1) & IC – Oct 2012
  - R104 Instrumented Typical Pavements – Feb 2013

Lab Testing – Ongoing

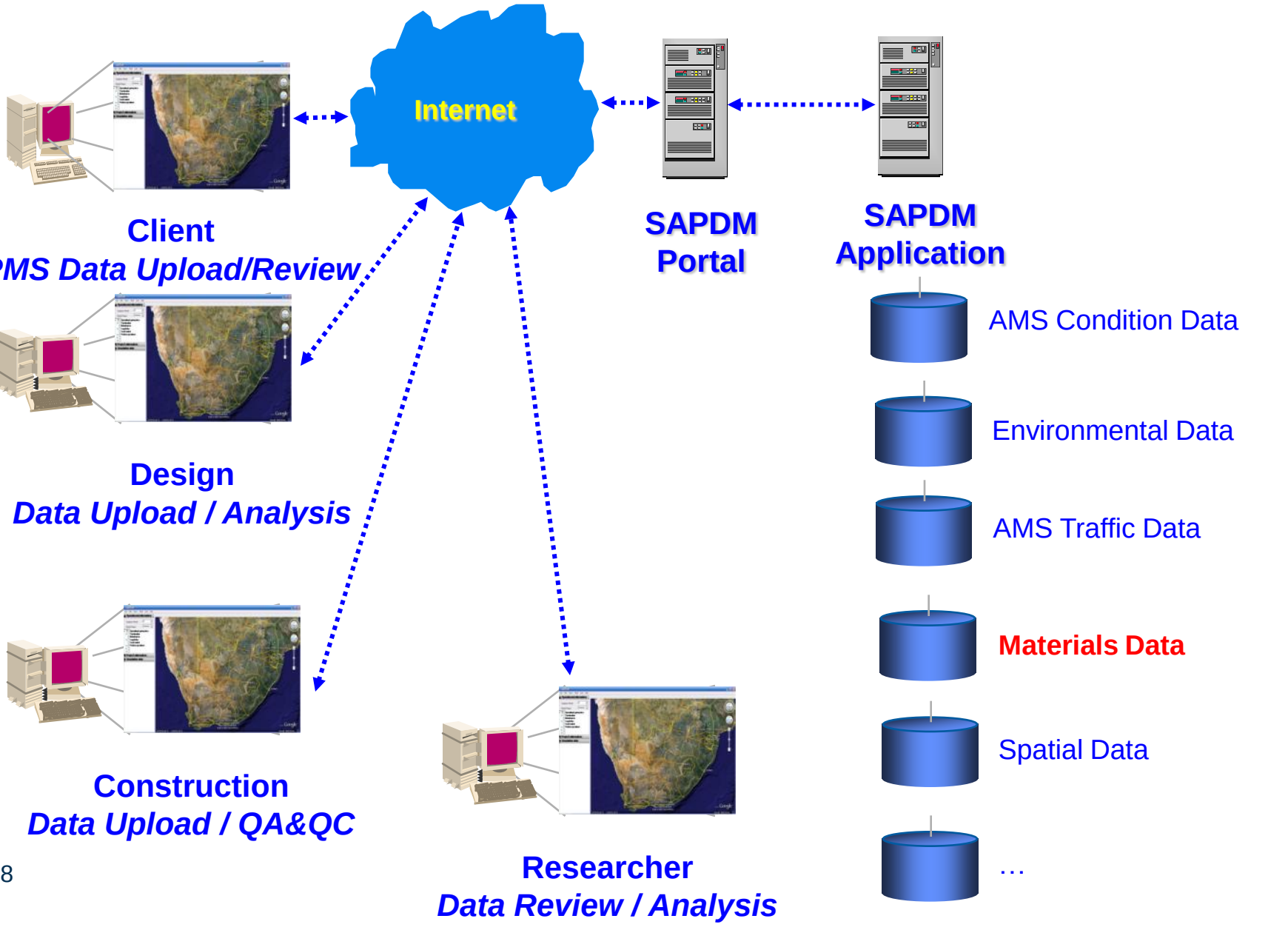
Dec 2010 = 6 Asphalt Mixes - Complete

Surface Seals – Work Started April 2011

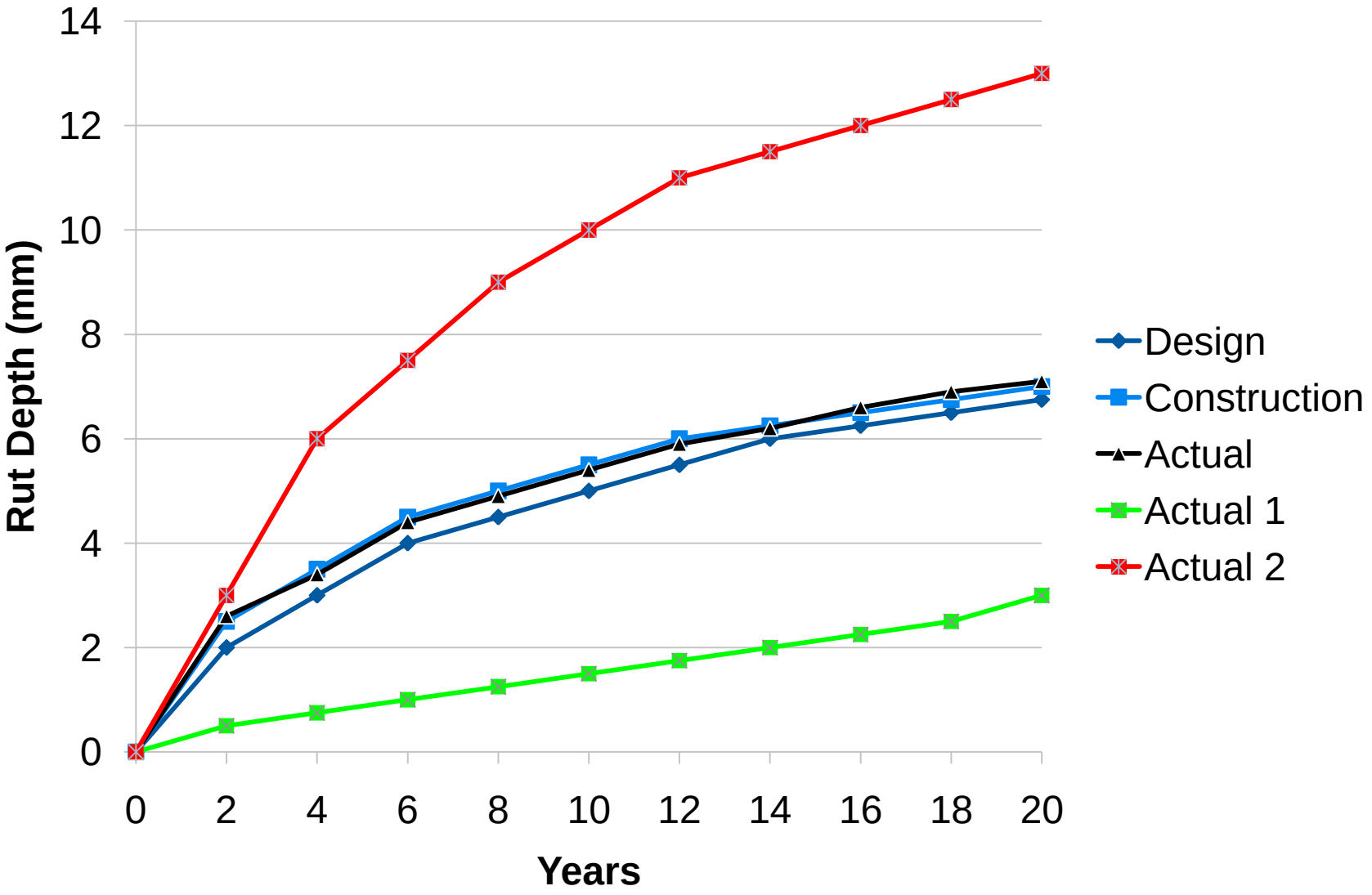
Concrete / Block Integration – Block Completed May 2012

SAPDM Building Blocks

SAPDM – Information Flow



Close the Loop Between Design/Construction/Research



Current South African Pavement Design Method

M N7 CS fast lane FWD 5-layer.mpd - mePADS

File Tools Setup Help

Pavement Structure | Loads and Evaluation Points | Contour Plot | Profile Plot

Number of Layers: 5 Number of Phases: 1 Default input: On Extra Layers

Phase 1

Material	Thickness (mm)	E-Modulus (MPa)	Poisson's Ratio	Slip Rate
AC	55	3500	0.45	0
G2	100	834	0.25	0
G2	100	379	0.25	0
G5	150	474	0.25	0
Subgra	0	100	0.35	0

Material	E-Modulus (MPA)	Poisson's Ratio

Material	E-Modulus (MPA)	Poisson's Ratio

Climatic Region: Moderate Terminal rut: 10 mm

Road Category: A Design Traffic class: ESO,003

Heading: N7/1 Cape Town to Malmesburry

Description: Crushed hornfels fast lane

CSIR our future through science

Technical support: James Maina
email: jmaina@csir.co.za

Software support: Yvette van Rensburg
email: yvrensburg@csir.co.za

Calculate | Pavement system changed. Recalculate!

NEW South African Pavement Design Method

SAPDM Primary Pavement Response Model v 0.0041

File Tools Help

- Pavement Structure
- Layer input
  - Layer 1
  - Layer 2
  - Layer 3
  - Layer 4
  - Layer 5
- Wheel loads
- Evaluation points
- Convergence
- Profile Plot
- Contour Plot

Calculate

Pavement Structure | Layer input | Wheel loads | Evaluation points | Convergence | Profile Plot | Contour Plot

Pavement description

Construction
Compaction roller vertical contact stress (kPa): 600

Analysis Method: Principle effective stress

Convergence control
Resilient modulus increment: 1.0
Poisson's ratio increment: 1.0
Number of iterations: 1

Sub-layering
Number of main pavement layers: 5
Number of sub-layers per main layer: 10

HMA Parameters
Latitude (°): -25.748487173
Longitude (°): -28.260323005
Select Map
Calendar year: 2011
Calendar month: 7
Day of the month: 16
Time of day: 15
Minimum ambient temperature (TAMIN): 3.8000
Maximum ambient temperature (TAMAX): 19.0000
Mean Monthly Ambient Temperature (MMAT): 11.6000
Reference temperature (TR): 20.0000
Time Lag (BETAT): 1.5000
Temperature decay (GAMAT): 3.9000
Witczak dynamic modulus (GAMA): 0.3134
Contact patch length (CPL): 300.0000
Vehicle speed (V): 80.0000

Pavement layer definition

Layer	Materal code	Thickness (mm)	Slip rate	Material type	Material description
1	AC	120	0	HMA	
2	G1	150	0	Linear-elastic	
3	C3	300	0	Linear-elastic	
4	G7	150	0	Linear-elastic	
5	Subgrade	2000	0	Linear-elastic	

NEW South African Pavement Design Method

SAPDM Primary Pavement Response Model v 0.0041

File Tools Help

- Pavement Structure
- Layer input
  - Layer 1
  - Layer 2
  - Layer 3
  - Layer 4
  - Layer 5
- Wheel loads
- Evaluation points
- Convergence
- Profile Plot
- Contour Plot

Calculate

Pavement Structure | Layer input | Wheel loads | Evaluation points | Convergence | Profile Plot | Contour Plot

Main pavement layer: Layer 1

General Parameters

Mix bulk relative density (BRDMi)	2.371	Binder absorption (%) (BAi)	0.004
Mineral aggregate bulk relative density (BRDMAi)	2.650	Linear thermal expansion coefficient (TEXi)	0.000020
Binder relative density (RDBi)	1.010	Viscous flow temperature (TFi)	20.000
Binder content by mass (%) (BCi)	0.050		

HMA aggregate grading

Percentage passing the 0.075 mm sieve (PP200i)	5.800
Percentage retained on the 4.75 mm sieve (P4i)	36.000
Percentage retained on the 9.5 mm sieve (P38i)	1.000
Percentage retained on the 19.0 mm sieve (P34i)	0.000

Binder complex modulus model parameters

α - parameter (ALPHABi)	13.9850(
β - parameter (BETABi)	-1.06700
γ - parameter (GAMABi)	-0.28600
δ - parameter (DELTABi)	-4.02500

HMA Model

Hirsch model

Binder complex modulus shift factor parameters

Cubic term parameter (SF2i)	0.00090
Linear term parameter (SF1i)	-0.15600
Constant term parameter (SF0i)	2.78000

Binder viscosity-temperature model parameters

Constant (cP) (Ai)	14.600
Slope (cP/°K) (VTSi)	5.60000

Poisson's ratio model parameters

a-parameter (PRAi)	-1.6300000(
b-parameter (PRBi)	0.00060000

ITIS

Registration

Upload Required Documents

Maximum file size - 1mb

ID Photo

Maximum file size - 2mb

ID Document

Cancel Previous Next

Registered to : SANRAL

Logged On : Philip Nobelis

Administration Module

Registration Management | User/Account Management | Product Management

Synchronize and Check for Updates

Product Name	Product Description	Product Type	License Enabled	License Start	License End
IDM Contract Module	Contract Management Module	CAB Module	Enabled	Tuesday, 01 May 2012	Wednesday, 01 May 2013
IDM Incident Module	Incident Capture Module	CAB Module	Enabled	Tuesday, 01 May 2012	Wednesday, 01 May 2013
IDM RRM Module	Routine Road Maintenance Module	CAB Module	Enabled	Tuesday, 01 May 2012	Wednesday, 01 May 2013
IDM Structure Module	IDM Structure Module	CAB Module	Enabled	Tuesday, 01 May 2012	Wednesday, 01 May 2013
ITIS Desktop	ITIS Desktop	CAB Shell	Enabled	Tuesday, 01 May 2012	Wednesday, 01 May 2013

Registered to : SANRAL

Logged On : Philip Nobelis

Incident Module

Synchronize Local Data | Incident Module Settings | Add Incident | Manage Conflicts

X.002-018-2012/1	Start : 2012/03/31	End : 2015/03/30
N00233N	0.00 km to 63.32 km	
N00234N	0.00 km to 97.31 km	
R03305N	16.10 km to 48.39 km	
R03306N	0.00 km to 35.98 km	
R03307N	0.00 km to 52.54 km	
N.002-025-2010/1	Start : 2010/05/31	End : 2013/05/30
N00202E	46.00 km to 67.70 km	
N00203E	0.00 km to 48.67 km	
Notified : 2012/06/13	at 3.00 km	
Notified : 2012/06/13	at 24.00 km	
Notified : 2012/06/13	at 30.00 km	
Notified : 2012/06/13	at 46.00 km	
Notified : 2012/05/18	at 9.00 km	
Notified : 2012/05/18	at 20.00 km	
Notified : 2012/05/18	at 23.80 km	
Notified : 2012/05/18	at 39.80 km	
Notified : 2012/05/18	at 42.40 km	
Notified : 2012/05/15	at 35.00 km	
Notified : 2012/04/18	at 15.80 km	
Notified : 2012/04/18	at 26.60 km	
Notified : 2012/03/15	at 20.80 km	
Notified : 2012/03/15	at 26.00 km	
Notified : 2012/03/15	at 29.60 km	
Notified : 2012/03/15	at 46.20 km	
Notified : 2012/02/13	at 0.10 km	

Edit Incident | Delete Incident | Save Changes | End Edit | Incident Report | Server Refresh

Notification and Location | Details and Condition | Traffic | Services | Damage | Photos | Validation | Map

Vehicle and Injury Details

Vehicle Number Plate	Vehicle Type	Count	Injury Type	Count
CEG3497	Motor Car	1	No Injuries	2

Choose | Delete | Add | Choose | Delete | Add | Delete | Add

No of Vehicles: 1 Entrapments: 0

Conditions and Cause

Weather Condition

☐ Clear ☐ Dust ☐ Fire ☑ Fog/Mist ☐ Hail ☐ Overcast ☐ Rain ☐ Snow ☐ Unknown ☐ Wind

Light Condition	Type of Incident	Cause of Accident
Daylight	Accident with animal	Animal

Incident Description

Car hit guineau fowl in road.

Waiting for Work

Structure Module

Allocated Structures | Bridge Capture | Major Culvert Capture

Lookup Synch | Synch Sign Off | Add Structure | Export to CSV | Update Allocations | Delete Structure

Package Structure Sort Order : Road KM

- GFIP Inspection 2012
  - Package B - SSI

N001_20N_IDC0330	other culve	Test Structure 234	CM	N001	20N	2.00	
N001_20S_B268B	3562	9th Avenue Underpass Bridge B	BR	N001	20N	27.40	
N001_20N_B268A	3562	9th Avenue Underpass Bridge A	BR	N001	20N	27.40	
N001_20N_B0038		7th Avenue Pedestrian Bridge (Replac	BR	N001	20N	28.03	
N001_20N_B267		7th Avenue Pedestrian Bridge (To Be f	BR	N001	20N	28.03	
N001_20S_B263B	3557	Rabie Street Underpass Bridge B	BR	N001	20S	32.80	
N001_20N_B263A	3557	Rabie Street Underpass Bridge A	BR	N001	20N	32.80	
N001_20S_B261B	3555	Cr Swart Drive Underpass Bridge B	BR	N001	20N	35.00	
N001_20N_B261A	3555	Cr Swart Drive Underpass Bridge A	BR	N001	20N	35.00	
N001_20N_B260	3554	Kleinjukskeisspruit	BR	N001	20N	35.60	
N001_20N_B189A	3396	Bryanstonspruit Bridge A	BR	N001	20N	37.20	
N001_20S_B189B	3396	Bryanstonspruit Bridge B	BR	N001	20N	37.20	
N001_20N_B187A	3395	Jakaranda Street Underpass Bridge A	BR	N001	20N	37.40	
N001_20S_B187B	3395	Jakaranda Street Underpass Bridge B	BR	N001	20N	37.40	
N001_20N_B185	3392	William Nicol Dr I/C: William Nicol Dr	BR	N001	20N	41.30	
N001_20N_B188C		Braamfonteinspruit Bridge C (Rivonia	BR	N001	20N	45.65	
N001_20N_B188A	3389	Braamfonteinspruit Bridge A	BR	N001	20N	45.80	
N001_20S_B188B	3389	Braamfonteinspruit Bridge B	BR	N001	20N	45.80	
N001_20N_B182C		Rivonia Road I/C: Underpass Bridge C	BR	N001	20N	46.24	
N001_20N_B182A	3388	Rivonia Road I/C: Underpass Bridge A	BR	N001	20N	46.24	
N001_20S_B182B		Rivonia Road I/C: Underpass Bridge B	BR	N001	20N	46.24	
N001_20S_B182D		Rivonia Road I/C Underpass Bridge D	BR	N001	20N	46.24	

  - Package D3 - ARQ

N001_21S_C0034		Drainage Culvert under N1S to R21S F	CM	N001	21S	23.16	
N001_21N_B470	3022	Brickfield Road Underpass	BR	N001	21S	23.59	
N001_21N_B472	2792	Rigel Avenue Interchange Bridge	BR	N001	21S	25.60	
N001_21N_B474A	2795	Dely Avenue Bridge 474a	BR	N001	21S	27.50	
N001_21S_B474B	2795	Dely Avenue Bridge 474b	BR	N001	21S	27.50	
N001_21N_B476	2797	Garstfontein I/C: Garstfontein Rd (M3(	BR	N001	21S	28.15	
N001_21N_SC033		City Of Tshwane Service Culvert 1	CM	N001	21S	28.53	
N001_21N_C2796		Wolwespruit Culvert Under Garstfonte	CM	N001	21S	28.55	
N001_21N_B0077		Atterbury Rd I/C: Atterbury Rd (M11) (	BR	N001	21S	28.94	
N001_21N_B478A	2799	Atterbury Rd I/C: Atterbury Rd (M11 W	BR	N001	21S	29.35	
N001_21N_B478B	2799	Atterbury Rd I/C: Atterbury Rd (M11 E	BR	N001	21S	29.35	

Structure Summary | Printing

Details of the selected structure are as follows :

Structure Number : N001_20S_B261B

Other Structure Number : 3555

Structure Name : Cr Swart Drive Underpass Bridge B

Route Number : N001

Section Number : 20N

Feature Name : C R Swart Drive

Road KM : 35.00

Download | Lock | Validate/Commit | Refresh | Unlock | Remove Local Data

Please note that maps as provided below should only ever be used as a rough guide.

General information | Bulk sample | Briquettes | Cores | Binder | Aggregate

Maximum theoretical density - TMH1 C4

Mass of	Flask (a)	Flask and sample (b)	Flask, sample and water (c)	Flask filled with water (d)	
Repeat 1	Edit Box	Edit Box	Edit Box	Edit Box	☑
Repeat 2	Edit Box	Edit Box	Edit Box	Edit Box	☑

Aggregate grading - TMH1 B4

Sieve size (mm)	Mass retained	Mass retained	Mass retaine
1.18			
0.600			
0.300			
0.150			
0.075			

Binder content - TMH1 C7(a) or C7(b)

TMH1 test method TMH1 test method

Binder relative density Edit Box

		Mass of dried sample, W (g)	Volume of solvent, V (ml)	Evaporating dish portions: Solvent volume, v (ml)	Evaporating dish portions: Mass of recovered binder, z (g)	
Repeat 1		Edit Box	Edit Box	Edit Box	Edit Box	☑
				Edit Box	Edit Box	
Repeat 2		Edit Box	Edit Box	Edit Box	Edit Box	☑
				Edit Box	Edit Box	
Mass of	Centrifuge cup(s) (b)			Edit Box		
	Cup(s) and dry filler (d)			Edit Box		

Aggregate ARD-BRD - TMH1 B14/B15

+4.75 mm fraction mass

Oven dry in air (A)	Edit Box
Surface dry in air (B)	Edit Box
Saturated in water (C)	Edit Box

-4.75 mm fraction mass

Oven dry sample in pycnometer (a)	Edit Box
Surface dry sample in pycnometer (b)	Edit Box
Pycnometer, sample and water (c)	Edit Box
Pycnometer filled with water (d)	Edit Box
Dry pycnometer (e)	Edit Box

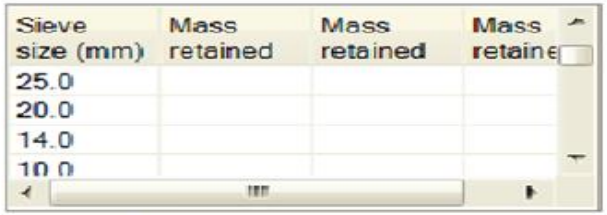
Binder content - TMH1 C7(a) or C7(b)

TMH1 test method TMH1 test method

Binder relative density Edit Box

Mass of	Oven dry sample (W)	Pan (a)	Centrifuge cup(s) (b)	Pan and oven dry aggregate (c)	Cup(s) and oven dry filler (d)	
Repeat 1	Edit Box	Edit Box	Edit Box	Edit Box	Edit Box	☑
Repeat 2	Edit Box	Edit Box	Edit Box	Edit Box	Edit Box	☑

C7(a) Direct Method
C7(b) Indirect Method



General information | Bulk sample | Briquettes | Cores | Binder | Aggregate

Maximum voidless density - SANS3001 AS11

Water temperature: Edit Box

Mass of	Flask asembly, M1 (g)	Flask and sample, M2 (g)	Flask, sample and water, M3 (g)	Flask filled with water, M4 (g)	Surface dry sample in air, M5 (g)	
Repeat 1	Edit Box	Edit Box	Edit Box	Edit Box	Edit Box	☑
Repeat 2	Edit Box	Edit Box	Edit Box	Edit Box	Edit Box	☑

Note: Leave entry for M5 blank when the aggregate does not absorb water

Soluble binder content - SANS3001 AS20

Binder relative density: Edit Box

Mass of	Centrifuge cup(s), Mc (g)	Oven dry sample, M2 (g)	Oven dry aggregate, Ma (g)	Cup(s) and oven dry filler, Mcf (g)	
Repeat 1	Edit Box	Edit Box	Edit Box	Edit Box	☑
Repeat 2	Edit Box	Edit Box	Edit Box	Edit Box	☑

Aggregate grading - SANS 3001 AG1

Sieve sizes Sieve sizes

Sieve size (mm)	Mass retained	Mass retained	Mass retaine
26.5			
19.0			
13.2			
9.5			

Aggregate ARD-BRD - SANS 3001 AG20/21

+ 4.75 mm fraction mass

Oven dry in air, M3 (g)	Edit Box
Saturated in water, M2 (g)	Edit Box
Surface dry in air, M1 (g)	Edit Box

- 4.75 mm fraction mass

Oven dry sample in air, M6 - M5 (g)	Edit Box
Surface dry sample in pycnometer M3 (g)	Edit Box
Pycnometer, sample and water, M4 (g)	Edit Box
Pycnometer filled with water, M2 (g)	Edit Box
Clean, dry pycnometer M1 (g)	Edit Box

General information | Bulk sample | Briquettes | Cores | Binder | Aggregate

Bulk relative density - TMH1 C3

Briquette number	Compaction temperature	Oven dry mass in air (a)	Surface dry mass in air (b)	Mass in water (c)	
Edit Box	Edit Box	Edit Box	Edit Box	Edit Box	☑
Edit Box	Edit Box	Edit Box	Edit Box	Edit Box	☑
Edit Box	Edit Box	Edit Box	Edit Box	Edit Box	☑

Marshall stability, flow and immersion index - TMH1 C2 and C5

30 minutes at 60 degrees

Briquette number	Height (mm)	Load (kN)	Flow (mm)	
Edit Box	Edit Box	Edit Box	Edit Box	☑
Edit Box	Edit Box	Edit Box	Edit Box	☑
Edit Box	Edit Box	Edit Box	Edit Box	☑

24 hours at 60 degrees

Briquette number	Height (mm)	Load (kN)	Flow (mm)	
Edit Box	Edit Box	Edit Box	Edit Box	☑
Edit Box	Edit Box	Edit Box	Edit Box	☑
Edit Box	Edit Box	Edit Box	Edit Box	☑

ITS - TMH1 A16-T

Briquette number	Edit Box	Edit Box
Height (mm)	Edit Box	Edit Box
Diameter (mm)	Edit Box	Edit Box
Load (kN)	Edit Box	Edit Box
	☑	☑

ITIS Mobile – Smartphone Application

User: Simon Plane Maintenance Module: 1.0

Task List | New JI | New MR | Settings

Location | Details | Estimates | Photos

Select Project	Select Section
P004.004.001	N00121N KM 12.02 TO KM 18.00
P004.003.001	N00121N KM 18.00 TO KM 21.00
P004.003.002	N00121S KM 12.02 TO KM 18.00

Job Category: ROUTINE

Position of work
- Carriageway
- Interchange
- General

Direction of work
- Positive (+)
- Negative (-)
- Both

Start KM: 14.23 End KM: 15

Start X: Y: GPS POSITION

End X: Y: GPS POSITION

CANCEL | Back | Next

User: Simon Plane Maintenance Module: 1.0

Task List | New JI | New MR | Settings

Location | Details | Estimates | **Photos**

Two lengths of guardrail damaged along positive direction.

General Photo

Enter photo description here

M440.01 Add Photo

CANCEL | Back | CONFIRM

SAPDM Detail Feedback

Title	Presenter
R35 Stabilisation & Intelligent compaction	**H Theyse / R Leyland**
R104 Instrumented Trial Sections	**W Steyn**
Environmental monitoring	**R Leyland**

Rating of Presentations

South African Pavement Design Method - Windows Internet Explorer

http://www.sapdm.co.za/

File Edit View Favorites Tools Help

Favorites | Visto Mouldings Profiles of C... | Suggested Sites | Free Hotmail | Web Slice Gallery

South African Pavement Design Method

Page | Safety | Tools

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- Project Management
- Public Documentation
- Project Team Documentation
- Frequently Asked Questions
- Disclaimer

Search: >>

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Password: >>

Not registered, click here | Forgot your Password, click here | Change password, click here

welcome to the South African Pavement Design Method Website...

About the project

Mechanistic-empirical pavement design has been one of the primary pavement design tools in South Africa since the early 1970s. Although some improvements were made to the original method over the years, the main components of the current method are still based on research done during the 1970s and 1980s. The problems associated with the current method were highlighted at the Conference for Asphalt Pavements in Southern Africa held in 2004. These problems were again raised at the subsequent Roads Pavement Forum meeting held in May 2005 and a workgroup appointed to initiate the revision of the South African Mechanistic-Empirical Design Method.

Project sponsors

Currently two sponsors have approved funding for the revision of the flexible pavement design method, the South African National Roads Agency Ltd (SANRAL) and the CSIR. CSIR funding covers mostly research activities to establish the foundation from which the development and implementation activities will be launched. SANRAL is the main sponsor and largest client body to implement the revised design method.

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PROJECT SPONSORS:

South African National Roads Agency Ltd. (SANRAL)

Council for Scientific and Industrial Research

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