tellenbosch

sabita
excellence in bituminous products

TG2 (2020)
Updates on the Design and Use of Bitumen Stabilised Materials

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BUILDING SOUTH AFRICA THROUGH BETTER ROADS

Introduction

History of BSM Manuals

Pavement Evaluation & Rehab Selection

Design Equivalent Material Classification

- DEMAC

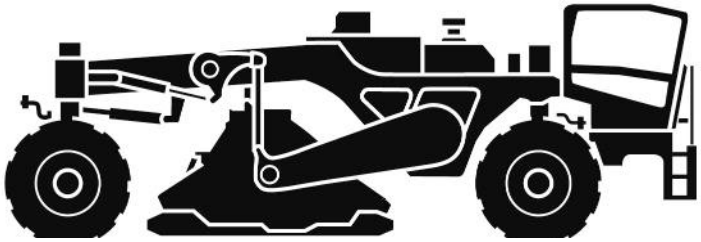
Mix Design Updates

Pavement Number

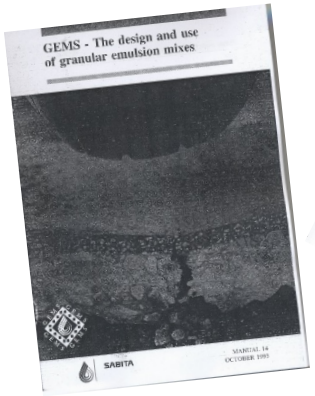
- 2009 & 2020

Mechanistic-Empirical

- New Stellenbosch function



History of BSM Manuals & Structural Design



SABITA Manuals (~1990s)

- GEMS
- ETBs

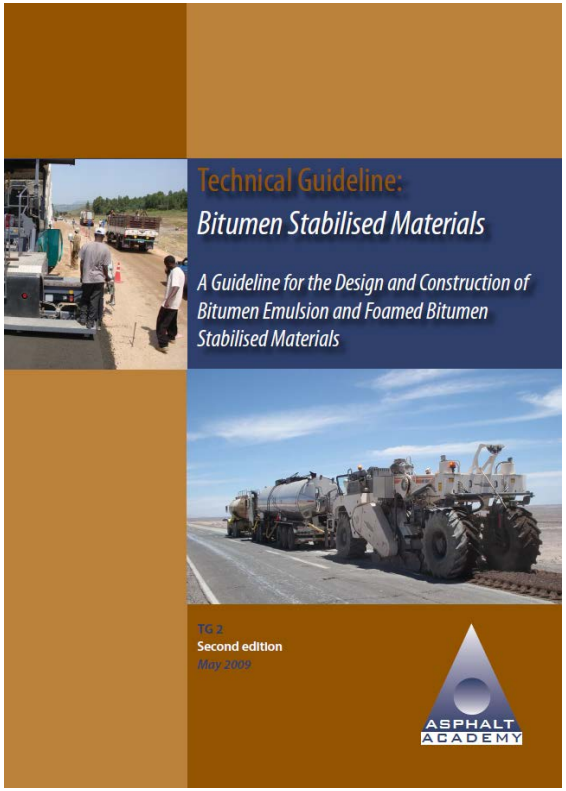
TG2 2002 (Asphalt Academy)

- Foam Bitumen
- ME Design Functions
- Conservative, developed on limited data

History of BSM Manuals & Structural Design

TG2 (2009)

- Both foam bitumen and bitumen emulsion
- Introduction of BSM term
- Insufficient data for ME design model
- Wanted to use field performance
- Pavement Number and DEMAC born
- PN used routinely now



TG2 (2020)

Detailed Pavement Investigations

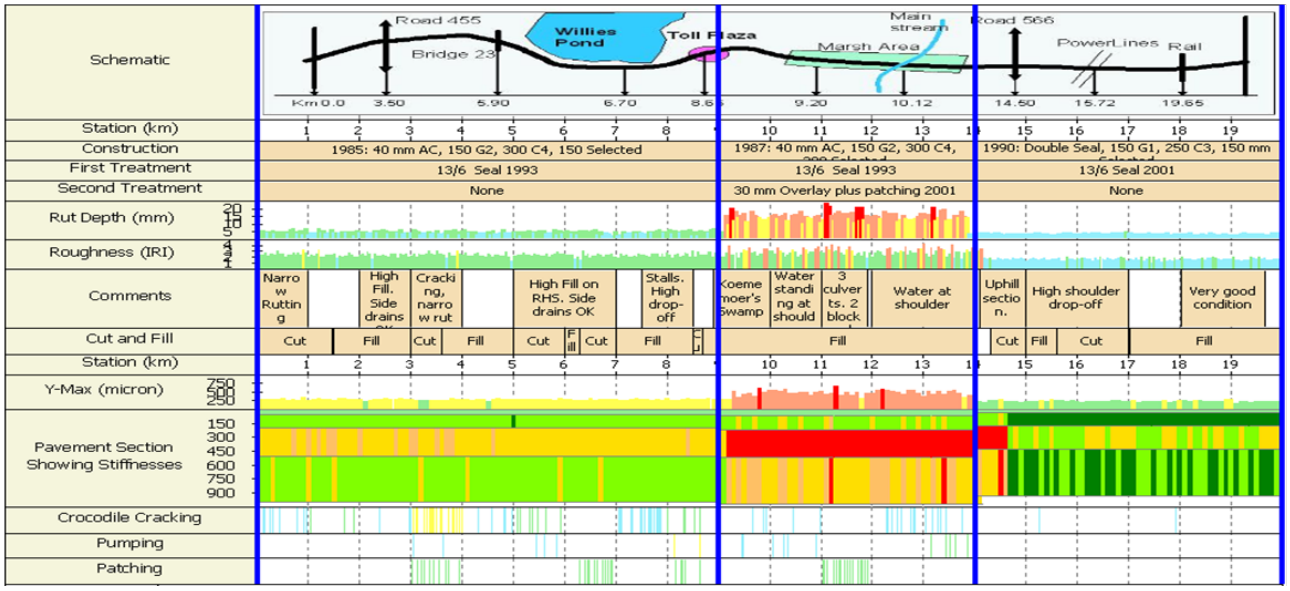
Visuals

FWD

DCP

Coring

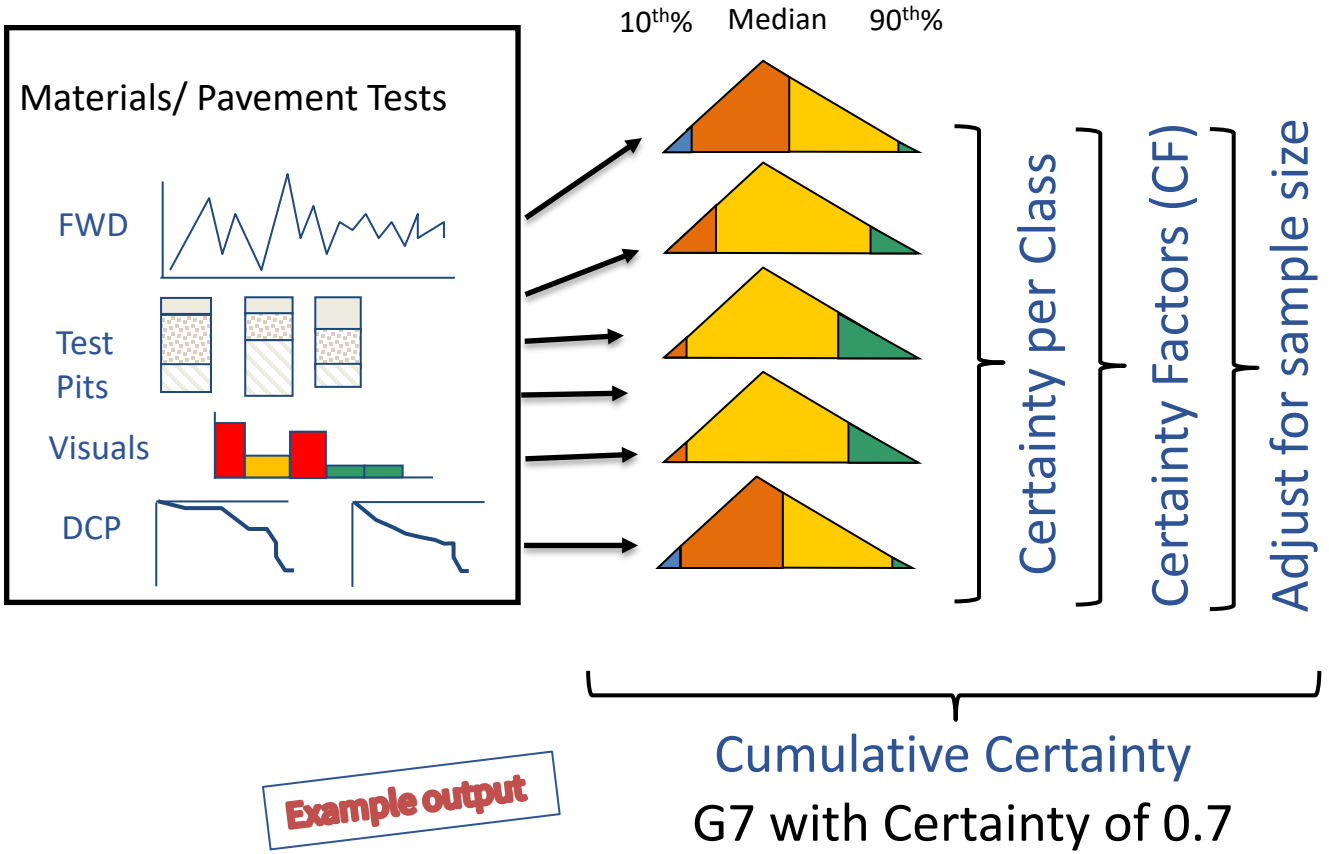
Test Pits



- Uniform Sections
- Layer thickness
- Material Class
- Distress Mechanisms
- Etc

DEMAC

Design Equivalent Material Classification System

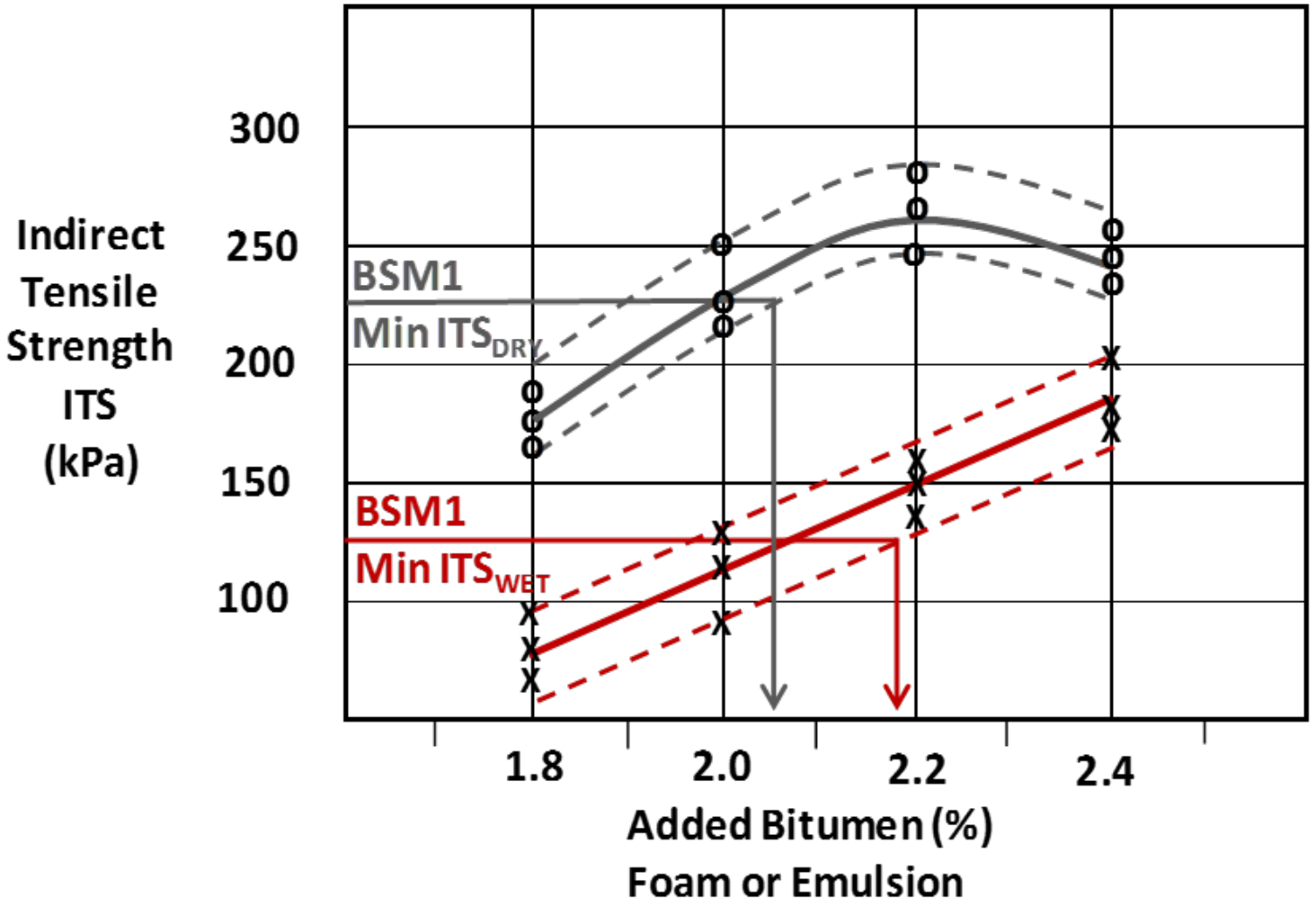


DEMAC System Update

- Update with latest performance studies and with industry standards
- Validation of Certainty Factors

Bayes factor	Evidence Category	CF
> 100	Extreme evidence for H_1	0.8 – 1.0
30 – 100	Very strong evidence for H_1	0.6 – 0.8
10 – 30	Strong evidence for H_1	0.4 – 0.6
3 – 10	Moderate evidence for H_1	0.2 – 0.4
1 – 3	Anecdotal evidence for H_1	0 – 0.2
1	No evidence	0

Mix Design
Select: Active Filler & Bitumen% - ITS

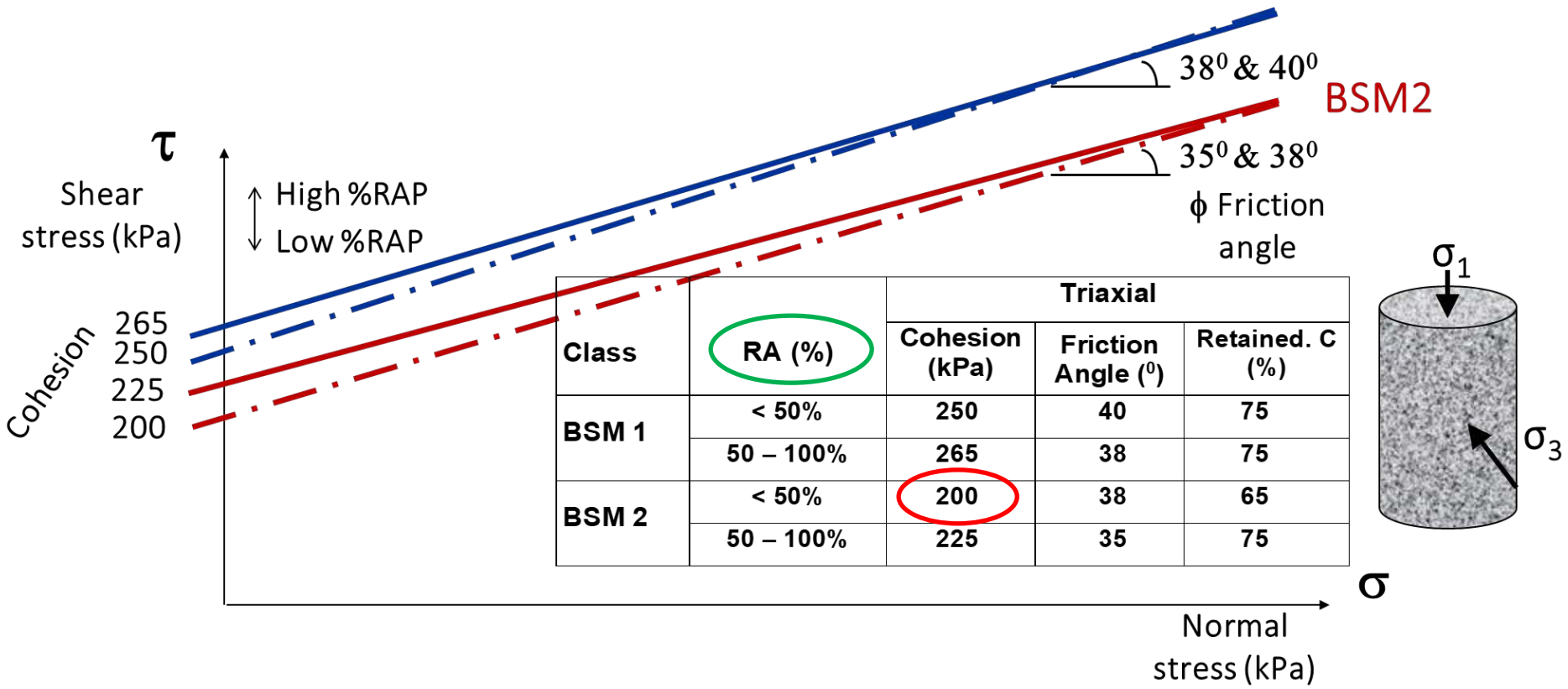


Mix Design Improvements: Triaxial Test

Test at 25^{0}C

Confining Pressure
0 kPa 50 kPa
100 kPa 200kPa

Triaxial Test Guideline Limits vs RA%



Class	RA (%)	Triaxial		
		Cohesion (kPa)	Friction Angle (⁰)	Retained. C (%)
BSM 1	< 50%	250	40	75
	50 – 100%	265	38	75
BSM 2	< 50%	200	38	65
	50 – 100%	225	35	75

Pavement Number

- Based on the Structural Number Concept (Old AASHTO method)
- Improved by incorporating established design principles
- Local experience
- Calibrated for long term field performance

PN 2009 - Data

Data Sets

- 20 field sites
- 7 HVS Sites (22 test sections)
- Construction, maintenance & performance information
- TRH4 Catalogues

PN - How does it work?

Climate

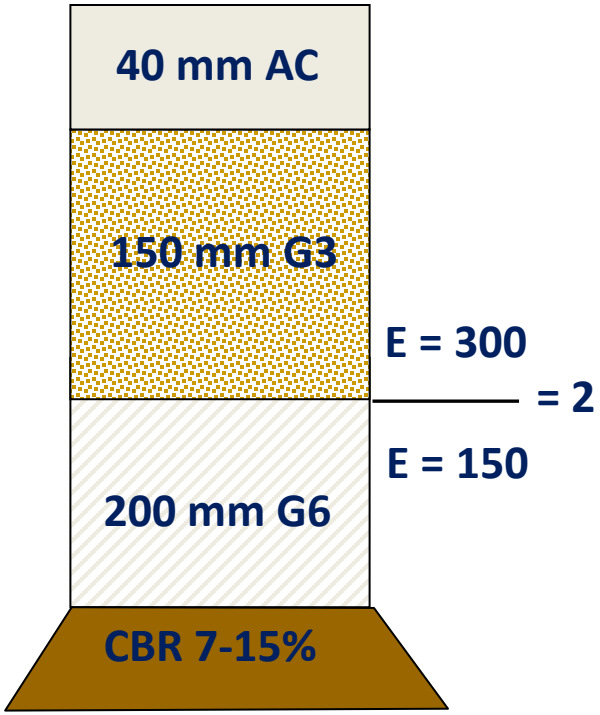
- Dry, moderate, wet

Subgrade

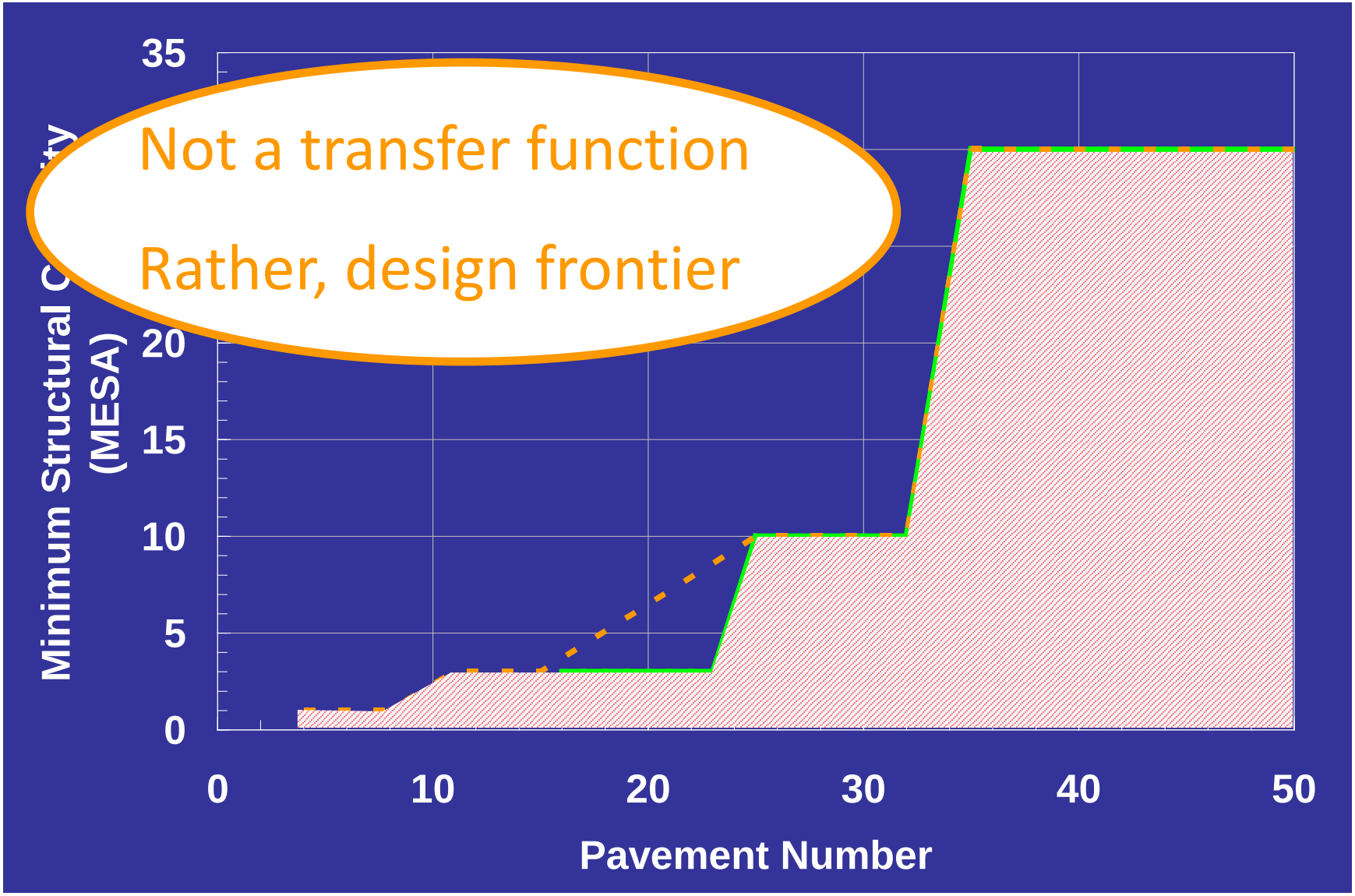
- Material class (DEMAC)
- Subgrade cover thickness

Layer materials

- Material class (DEMAC)
- Modular Ratio
- Maximum allowed stiffness
- Thickness adjustment factor for C3 & C4
- Base confidence factor



PN 2009 – Design Frontier



PN 2009 - Issues

Over contribution of asphalt

Under contribution of cemented materials

Asphalt layers

- Limited to < 50 mm

No asphalt bases

Increase in PN, no increase in life

Limited to 30 MESA

PN 2020 – Data

69 LTPP Sections

TRH 4 Catalogues

SATCC Catalogues

PN ~~2009~~ - Issues 2020

Over contribution of asphalt ✓

Under contribution of cemented materials ✓

Asphalt layers ✓

- Limited to < 50 mm 20 – 100 mm

No asphalt bases ✓ 20 – 200 mm

Increase in PN, ~~no~~ increase in life ✓

Limited to ~~30~~ 40 MESA ✓

PN 2020 – What Else is New?

Thickness adjustment factor for stabilized layers

- Asphalt
- Cemented
- BSMs

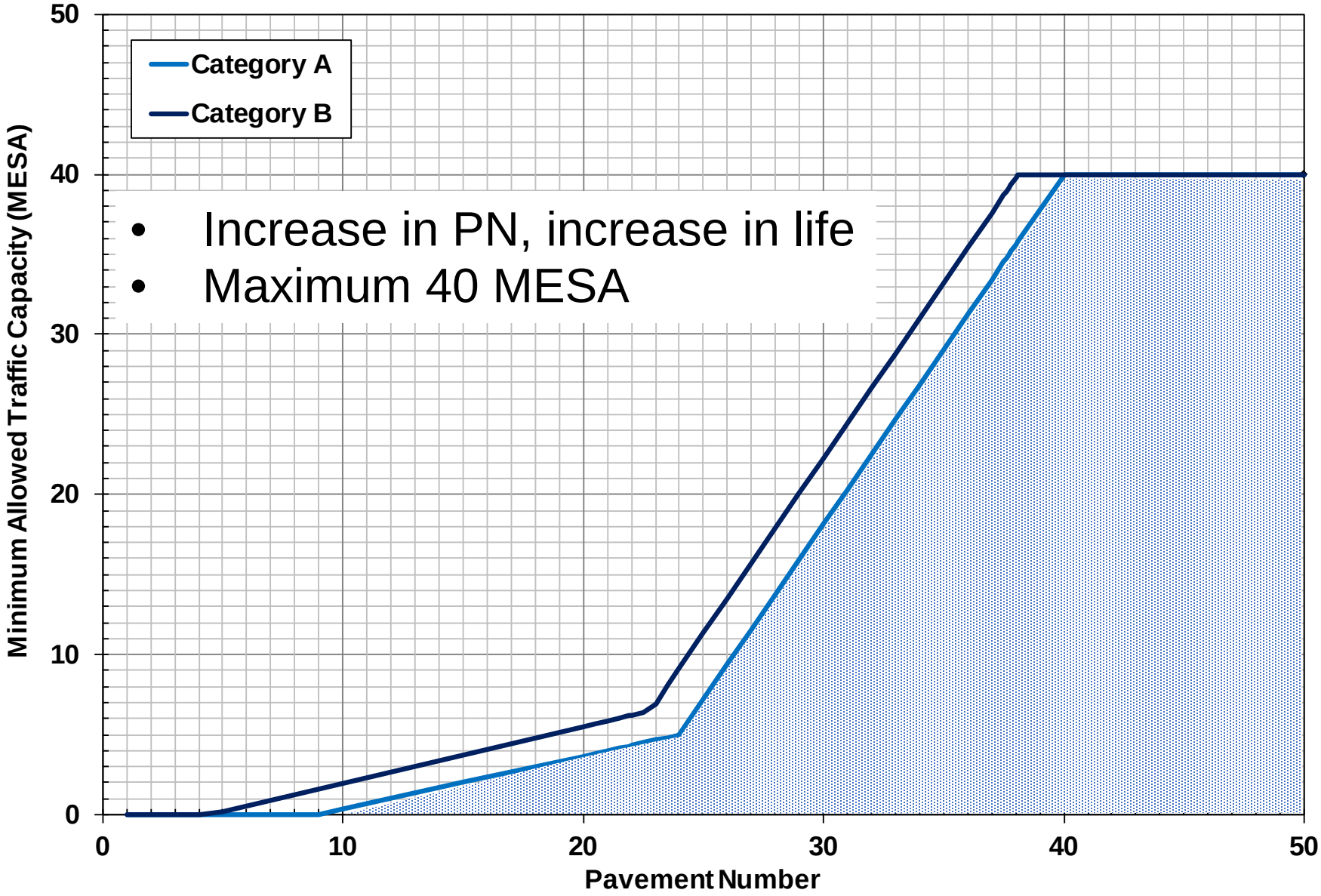
Materials

- Asphalt bases
- EG 4 & 5

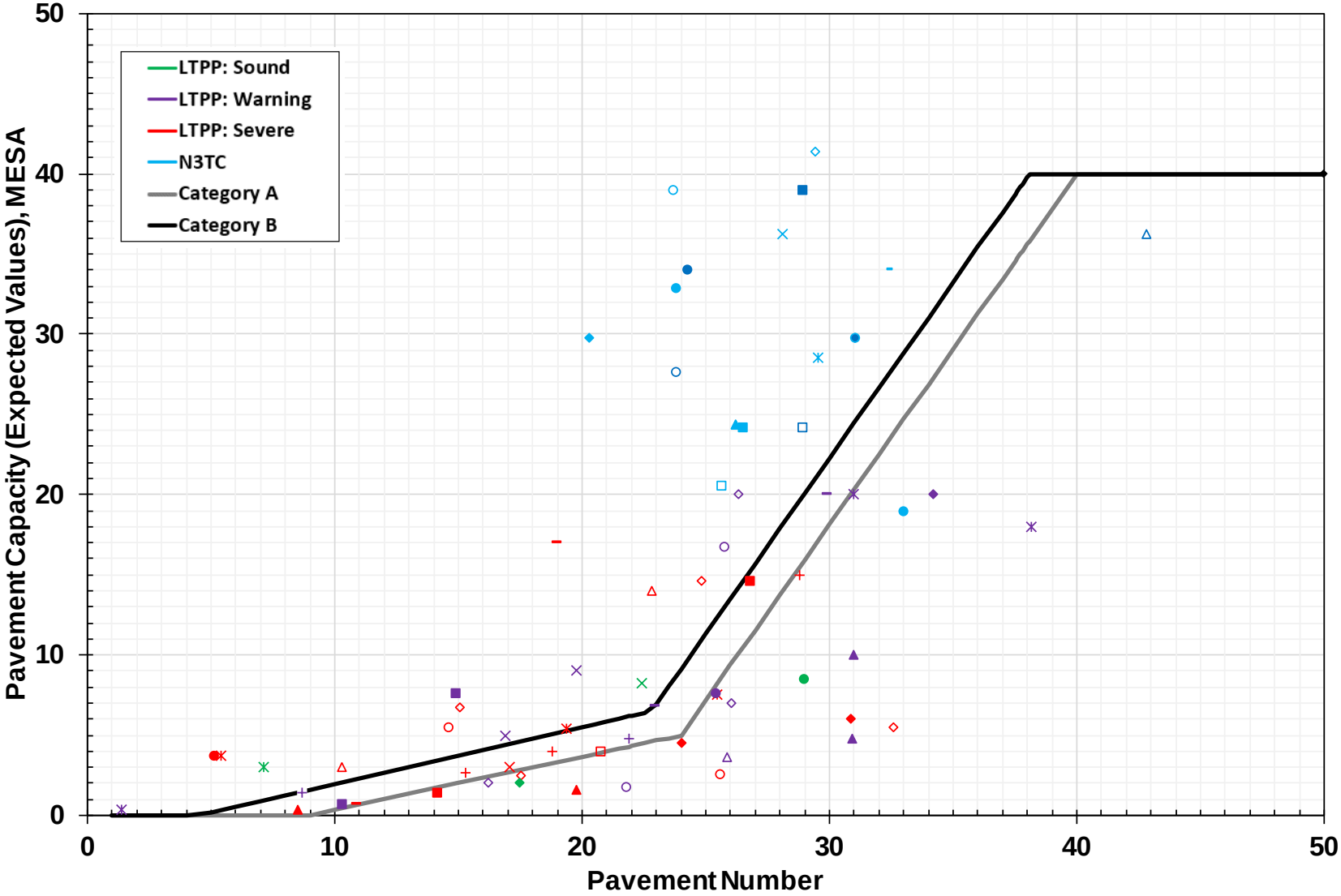
Seals are 10 mm thick

New Frontier Curve

PN 2020 – Frontier Curve



PN 2020 – Calibration

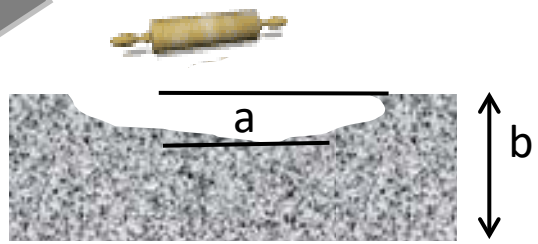


New ME Structural Design Function

Plastic Strain % (a/b)

P_{MDD} = % Mod.AASHTO

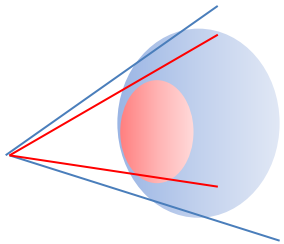
Reliability	A	Rut Limit (mm)
95%	1.71113	10
90%	1.79873	15
80%	1.88733	20
50%	2.00443	25



$$logN = A - 57.286(DSR)^3 + 0.0009159(P_{MDD}.RetC)$$

Deviator Stress Ratio

DSR power	Slope	Intercept	R^2
2	1.025	-0.5945	0.819
3	1.001	1.0572	0.927
4	1.1296	6.9172	0.355

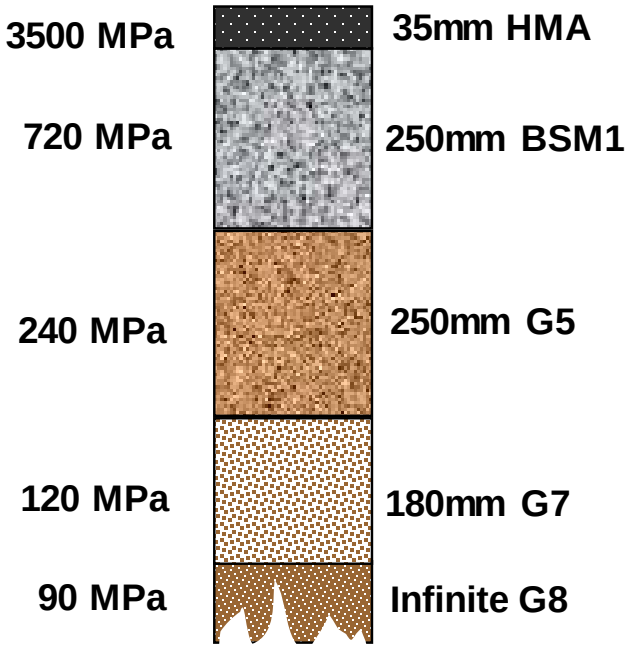


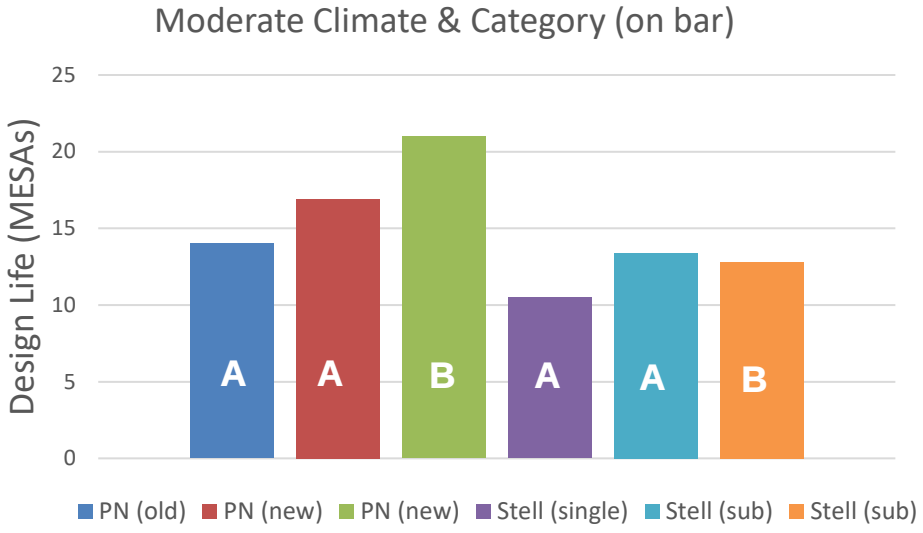
Retained Cohesion

ME – Recommended Inputs

Class	Percent of Reclaimed Asphalt	ITS (kPa)		Triaxial		
		ITS_{DRY}	ITS_{WET}	Cohesion (kPa)	Friction Angle (°)	Retained Cohesion (%)
BSM 1	< 50%	225	125	250 – 300 (250)	40 – 50 (40)	70-85 (75)
	50 – 100%	225	125	265 – 350 (265)	38 – 45 (38)	75-90 (75)
BSM 2	< 50%	175	100	200 – 250 (225)	38 – 40 (39)	65-75 (70)
	50 – 100%	175	100	225 – 250 (238)	35 – 40 (37)	70-85 (75)

Comparison of Results





Note: Single layer & Sub-layer Analysis at ¼ depth

Conclusion

Inclusion of Pavement Investigation Strategy

Advances in Mix Design

- Triaxial Testing
- DEMAC revisions

Advances in BSM structural design

- Pavement Number revisions
- New ME function, with recommended inputs

Applicable to all pavement design, not just BSM

Additional Focus on In plant Application

Thank You & Happy Recycling