

# TG2 Update

## BSM technology

### Foamed Bitumen and Emulsion

Kim Jenkins  
Fenella Johns  
Arno Hefer

**RPF**

**12 November 2018**



tellenbosch



Reg. No.1998/009584/06



# Chapters of updated TG2

1. Introduction
2. BSM Usage & Design
3. Investigations & **Classificatn.**
4. Mix Design
5. Structural Design **(PN)**
6. Application



2012



2009



2002



**Std Test Method**



**Vibrating Hammer**

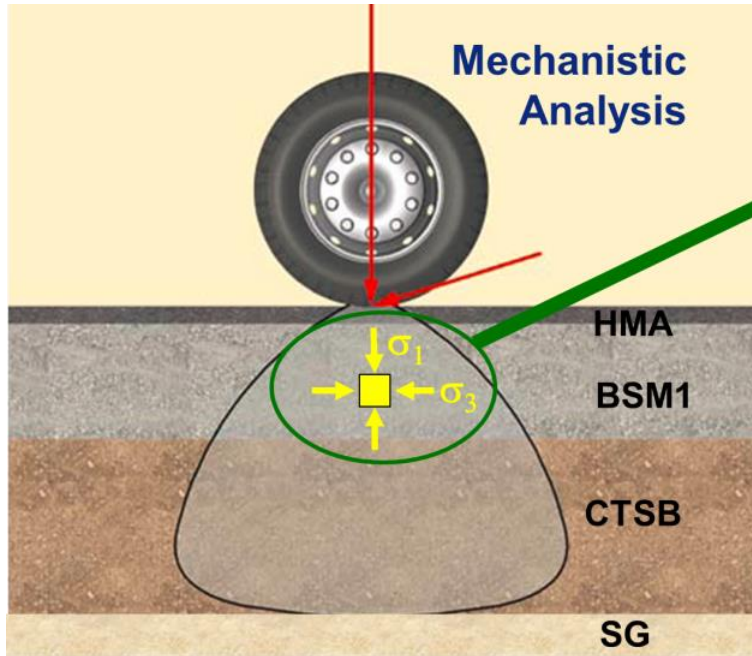
# Triaxial Test Method



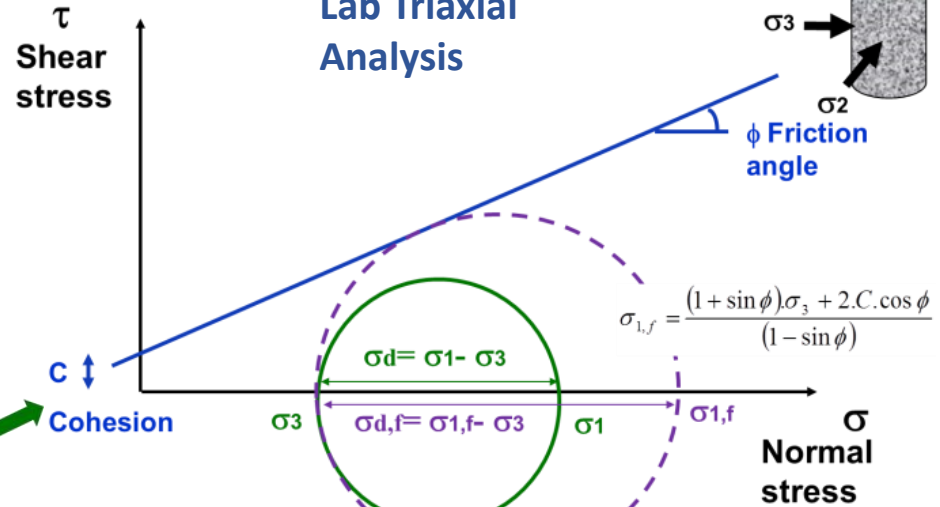
**APPROVED**

# BSM Design for Max Rut Depth

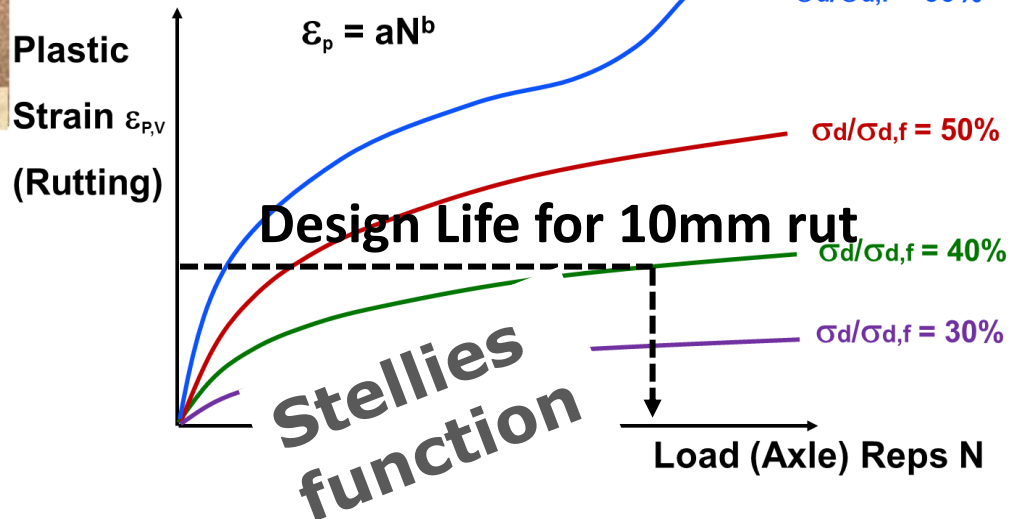
(same principle as Granular Design)



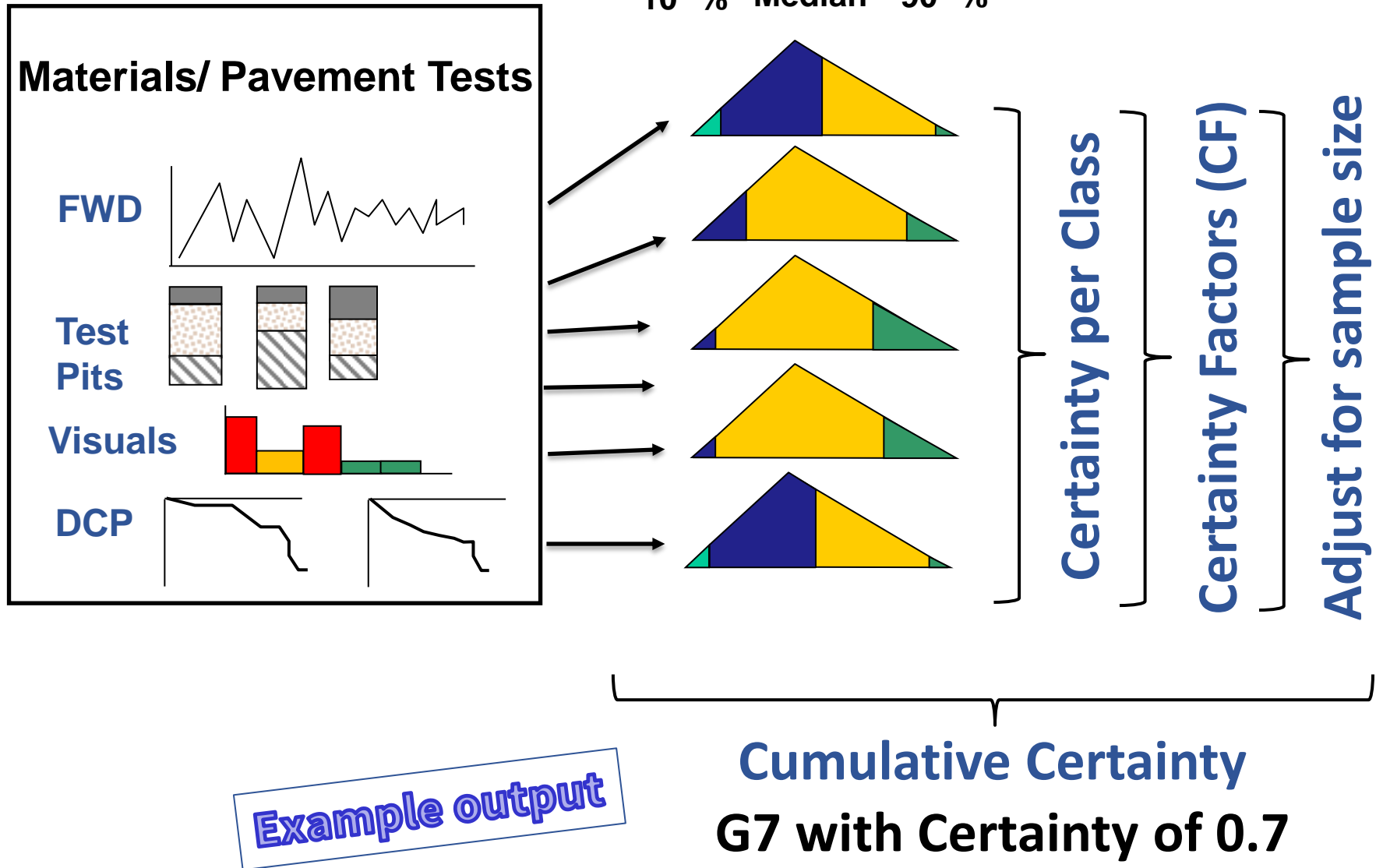
Permanent deformation (rutting) design for granular material



Stress Ratio  
 $= \sigma_d / \sigma_{d,f}$



# Materials Classification System



# **Focus of System Revision**

- **Introducing rules to assign material types (CS, NG, GS, SSC)**
- **Validate Certainty Factors**
- **Updated and new material class rules**
- **Recommended Application**

# Validation and Update

- **Certainty Factors**
  - **Theyse (2007)**
  - **NCHRP (2001)**
- **Material Type and Class rules/criteria**
  - **PPIS/ LTPP**
  - **Selected projects**

# Certainty Factors

- **Bayesian Approach (via Bayes Factors)**
  - **Quantify amount of evidence in the data**
  - **Not doable with classic hypothesis testing**

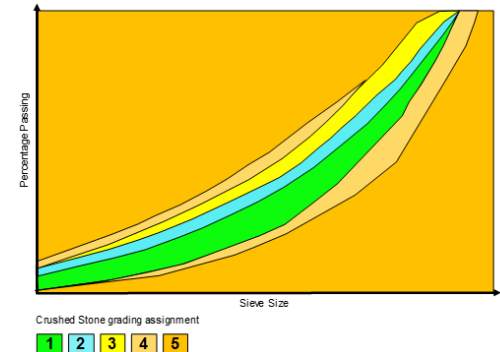
Bayes factor	Evidence Category	CF
> 100	Extreme evidence for $H_1$	0.8 – 1.0
30 – 100	Very strong evidence for $H_1$	0.6 – 0.8
10 – 30	Strong evidence for $H_1$	0.4 – 0.6
3 – 10	Moderate evidence for $H_1$	0.2 – 0.4
1 – 3	Anecdotal evidence for $H_1$	0 – 0.2
1	No evidence	0



# Granular Materials

- **New Rules**

- **CS – Fractured faces, PI (P075), grading evaluation**
- **Linear shrinkage**



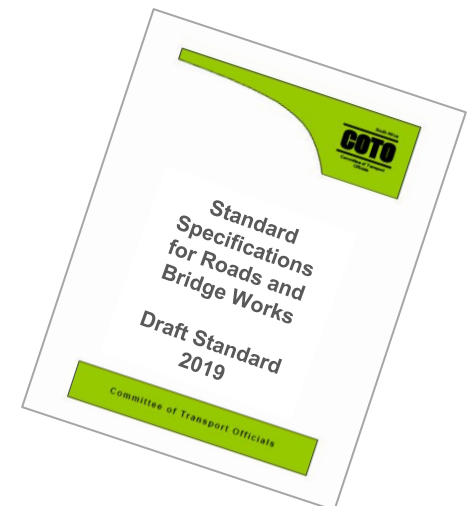
- **Revision**

- **COTO Draft Standards**
- **Materials database (PPIS, projects)**



# Cemented Materials

- **New Classes**
  - **DE-EG4, DE-EG5**
- **New Rules**
  - **FWD Maximum Deflection**
  - **Visual data**
  - **Lab data (Grading, PI, CBR)**
- **Revision**
  - **COTO Draft Standards**
  - **Materials database**



# Interpretation/ Application

Certainty	Classification Confidence	Recommended Application
< 0.3	Very Low	Inadequate
0.3 – 0.5	Low	Category D
0.5 – 0.7	Medium	Category C (0.5 – 0.6)
		Category B (0.6 – 0.7)
> 0.7	High	Category A

# **Pavement Number Revision**

- **PN first published in TG2 in 2009**
- **Well received & widely used**
- **But some issues...**

# Pavement Number Issues

- **Maximum 30 MESA**
  - Frontier Curve development
- **Asphalt max thickness 50 mm**
- **Layer contribution to PN**
  - Asphalt – too much
  - Cemented – too little



# Recalibration

- **Much larger data set**
  - **67 LTPP sections (Updated traffic & condition)**
  - **TRH4 Catalogues**
  - **SATCC Catalogues**
- **Pavement types:**
  - **BTB 8**
  - **BSM 21**
  - **CTB 11**
  - **Gran/Cem 18**
  - **Gran/Gran 9**
  - **Seals 16**
  - **Asphalt 51**

Material Class	Modular Ratio	Max Allow. Stiffness	Base Confidence
Asphalt	<del>5</del> 4	<del>2500</del> 2000	1
Seals	2	800	N/A
BTB	4	1500	1
BSM1	3	<del>600</del> 700	1
BSM2	<del>2</del> 2.5	<del>450</del> 600	0.7
G1	3	<del>700</del> 500	<del>1.1</del> 1
G2	<del>2</del> 1.9	<del>500</del> 450	0.8
G3	<del>2</del> 1.8	400	0.7
G4	1.8	375	0.2
G5	1.8	320	0.1
G6	1.8	<del>180</del> 250	-2
G7	1.7	140	-2.5
G8	1.6	100	-3.0
G9	1.4	90	-4.0
G10	1.2	70	-5.0
C3	4	<del>550</del> 400	0.6
C4	3	<del>400</del> 300	0.4

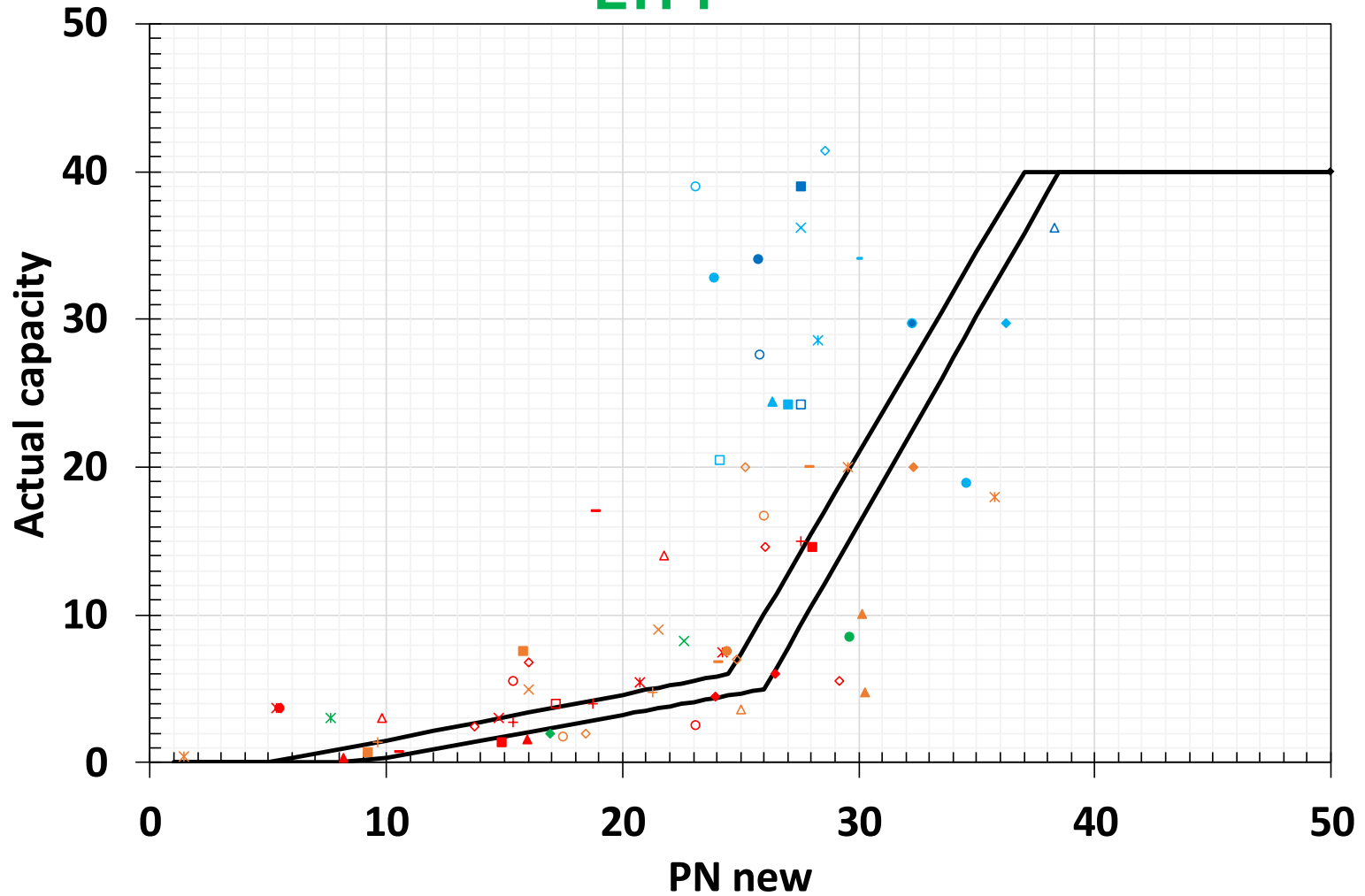


# Recalibration

- **Shift functions for thickness:**
  - **Cemented layers**
  - **Asphalt surfacings and BTB**

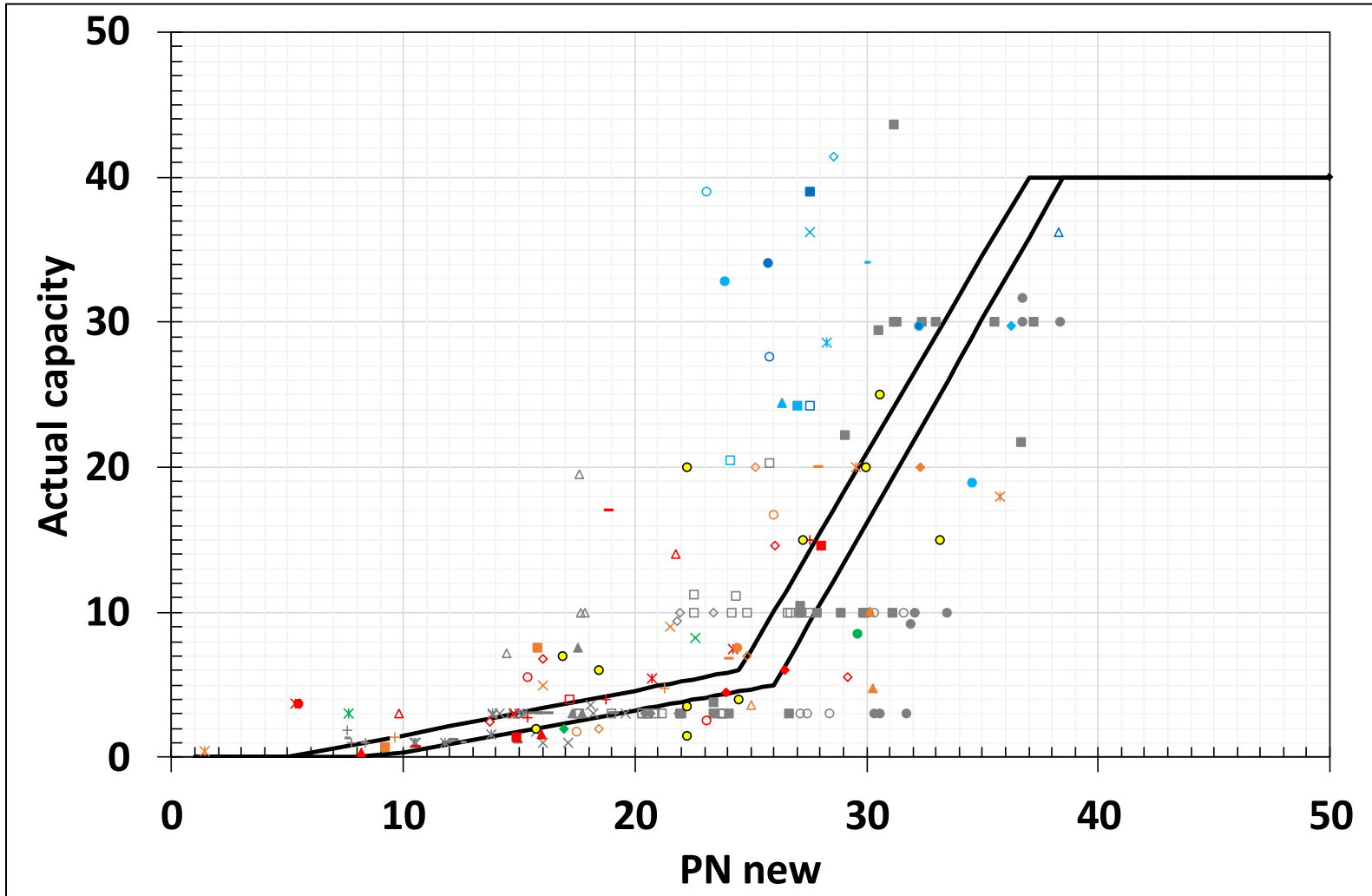
# New Frontier Curve

LTPP



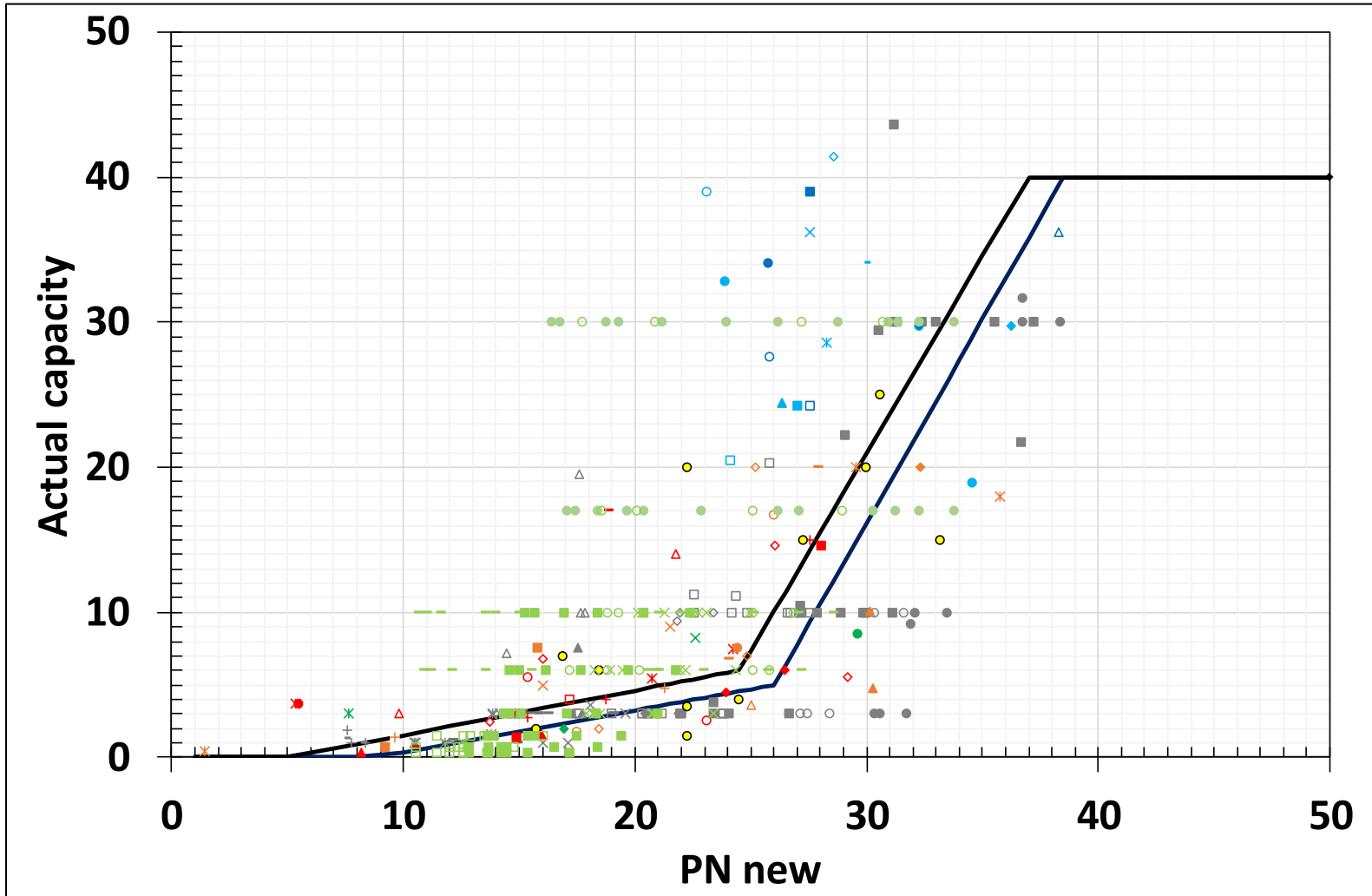
# New Frontier Curve

LTTP, TRH & HVS



# New Frontier Curve

LTPP, TRH, HVS & SATCC



# What now?

- **Full details in new TG2 and SAPEM (when updated)**
- **Use it!**
- **Share feedback**

# Conclusions

- Investigation for rehab (new)
- Mix design system in place (new tests)
- Pavement design
  - **Classification System Update**
  - **PN update**
  - New ME design function
- Application (in plant and in place)
- Revised TG2 available 1<sup>st</sup> quarter 2019



**The sky's the limit!**

**Thank you!**