



# Deflection of wearing courses

Donatien de Lesquen (Eiffage)

Contributors: Julien Van Rompu (Eiffage), Alain Hebting, Nadège Sagnard, Hugues Odéon (Cerema)



- Presentation of the ACTE guide
- Objectives
- Methodology
- Main results
- Conclusions



- Suburban and rural road pavements
- Maintenance work: a single course < 8 cm thick (ACTE, 2003)
- Define deflection threshold values as a function of traffic
- Little information available: Existing structure? Bonding of courses?
- No methodology for choosing variants

#### 4 - Technique : Béton Bitumineux Très Mince

##### 1 - Domaine d'emploi

###### Destination :

Renouvellement de la couche de roulement

###### Trafic :

Tous trafics

###### Épaisseur :

Moyenne : 2 à 3 cm (45 à 65 kg/m<sup>2</sup>)

Mini : 1,5 cm

###### Contre Indication d'Emploi :

Mise en oeuvre manuelle, giratoire

##### 2 - État du support

###### Déflexions :

Trafic ≤ T3 : < 100/100 mm

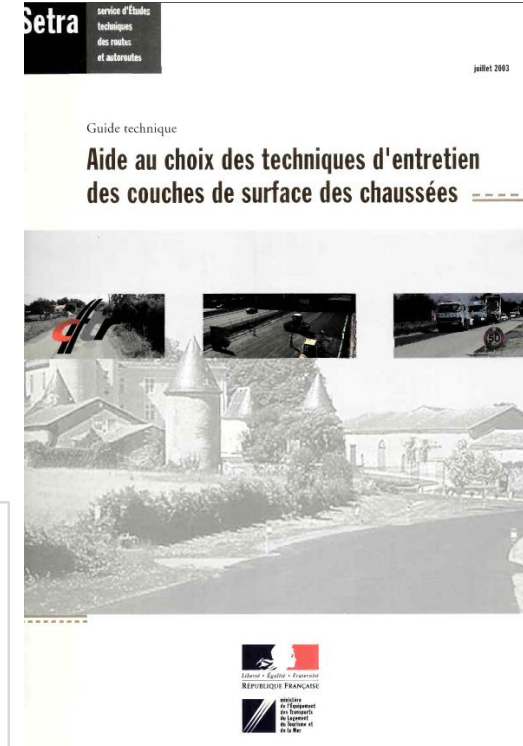
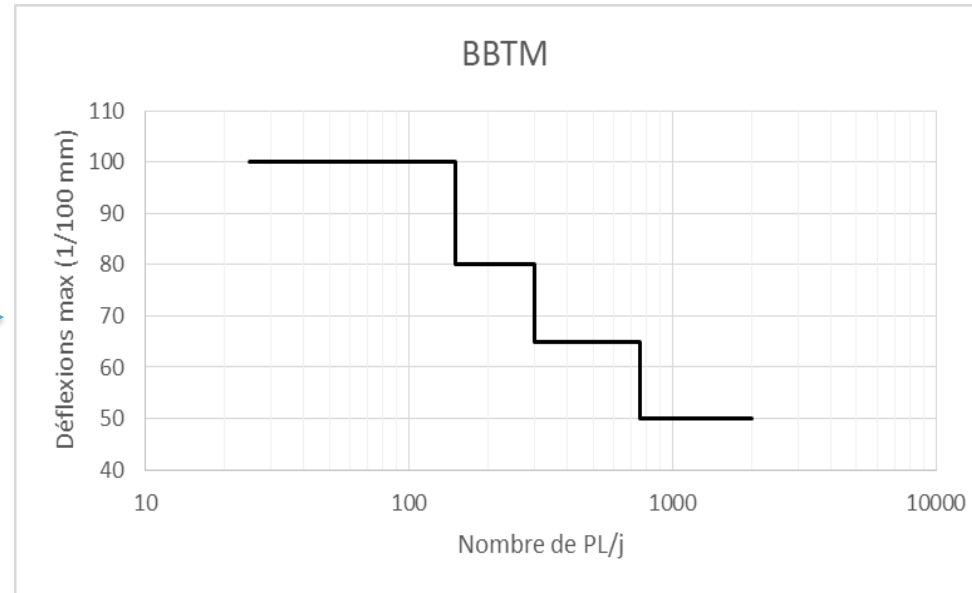
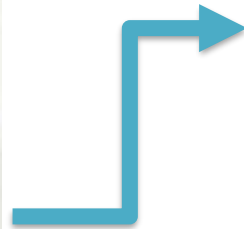
Trafic T2 : < 80/100 mm

Trafic T1 : < 65/100 mm

Trafic ≥ T0 : < 50/100 mm

###### Orniérage :

< 1cm



## Deflection values as a function of traffic in various guides:

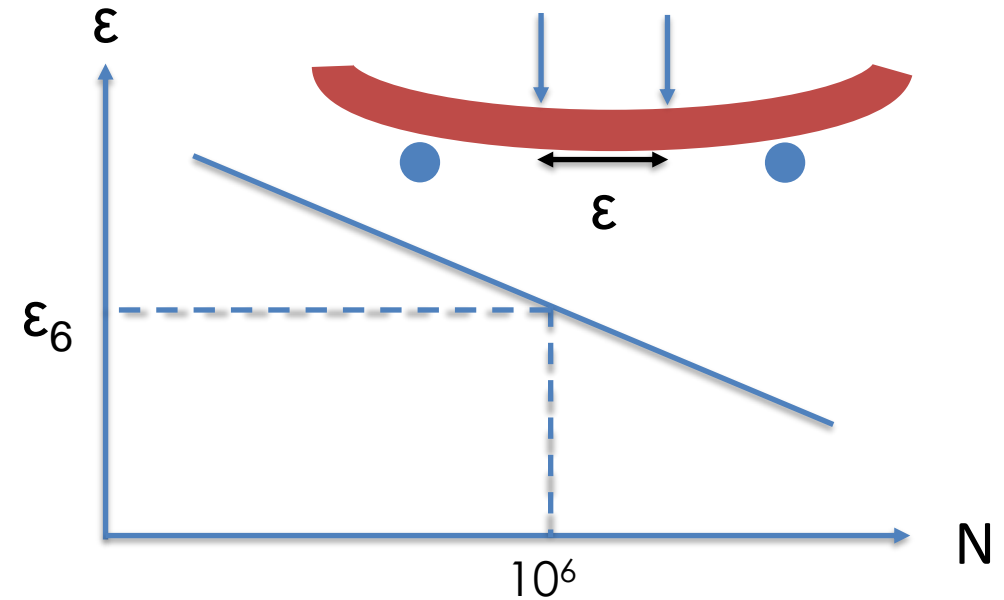
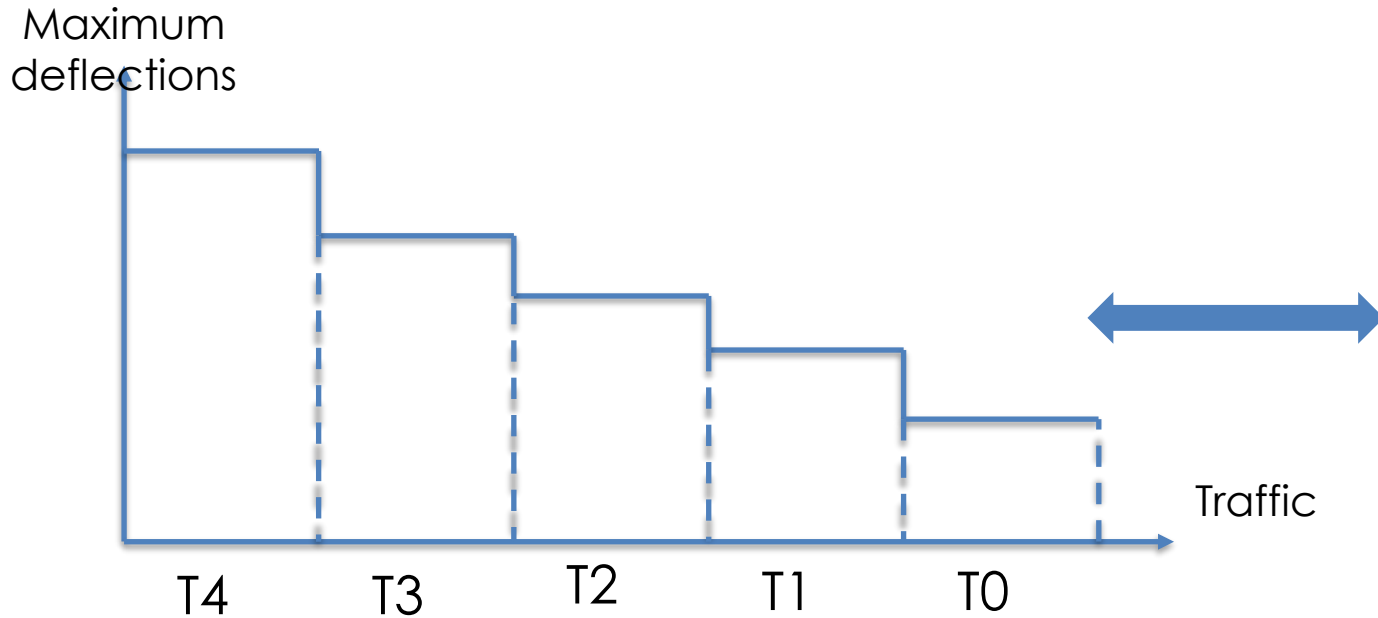
- The ACSE guide: Aide au Choix des Solutions d'Entretien (*Help choosing maintenance solutions*) – September 1990
- Guide d'application des normes pour le réseau routier National (*Standards Application Guide for the National Road Network*). SETRA LCPC – 1994
- Entretien préventif du réseau routier national (*Preventive maintenance of the national road network*). SETRA – 1979

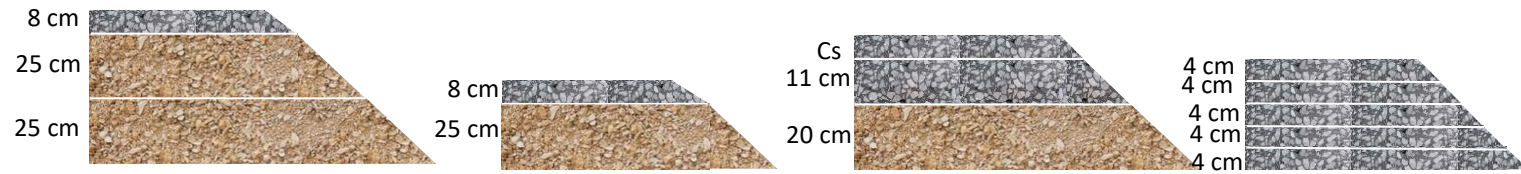
## Interviews with the ACTE guide writers:

- ⇒ Empirical approach: specifications based on feedback from network operators
- ⇒ No validation using an experimental/rational method



- Implement a **rational approach** to choosing wearing courses based on their deflection behaviour
- Define a **permissible load** → analogy with **fatigue strength**
- Verify the requirements of the ACTE guide via a laboratory test: apply a cyclic deformation  $\epsilon$  until failure





- 4 typical structures (catalogue 98 + multilayer structure)
  - Soil modulus (20, 50, 80, 120, 200 MPa)
  - Modulus of GNT sub-layers in accordance with the Idrrim guide
  - Modulus of bituminous courses (1000, 2000, 4000 and 6000)
  - Quality of the bonding of the courses.
- ▶ **Idrrim-Cerem guide: Diagnosis and design of road pavement reinforcements (May 2016)**





## Alizé-Lcpc v1.5

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	S	numéro module	module sol	module Cdl	collag	déflex	Rc 1H	nouve	$\epsilon T_{su}$	$\sigma T_{su}$	$\epsilon Z_{su}$	$\sigma Z_{su}$	$\epsilon T_{inf}$	$\sigma T_{inf}$	$\epsilon Z_{inf}$	$\sigma Z_{inf}$	déflex	R cou
2	2	2	35	1000	collé	171,8	45	BBSG3	31	1,087	-172,8	0,66	-170,7	-1,509	194,2	0,383	115,7	126,5
3	2	2	35	2000	collé	164,4	51,7	BBSG3	61,7	1,244	-172,5	0,66	-87,9	-0,662	120,5	0,418	108,2	163,5
4	2	2	35	4000	collé	156,2	62,3	BBSG3	88,2	1,386	-159,5	0,66	-18,7	0,045	58,4	0,445	100,6	215,9
5	2	2	50	1000	collé	122,9	60,6	BBSG3	6,7	0,774	-136,9	0,66	-148,8	-1,285	176,7	0,402	85,6	148,1
6	2	2	50	2000	collé	117,8	68,4	BBSG3	38,4	0,958	-140,5	0,66	-77,1	-0,548	112,3	0,434	80,6	189,6

Identification of the structure studied  
 (Structure number, soil and bituminous  
 course modulus, etc.)

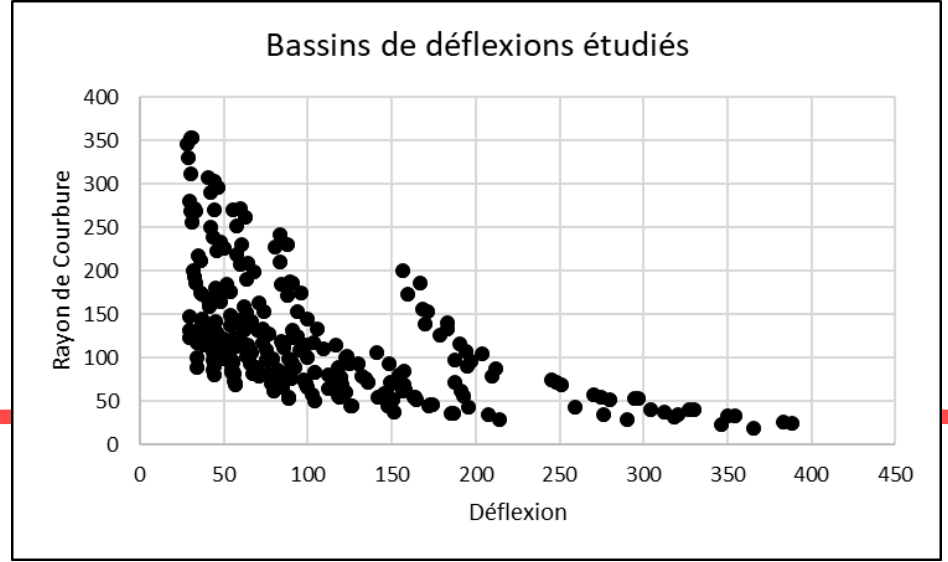
Deflection  
 basin 1 Hz

New CoR

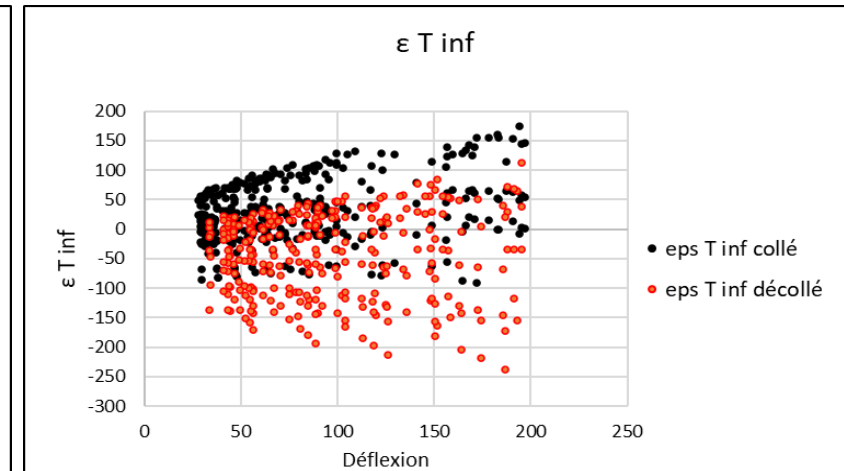
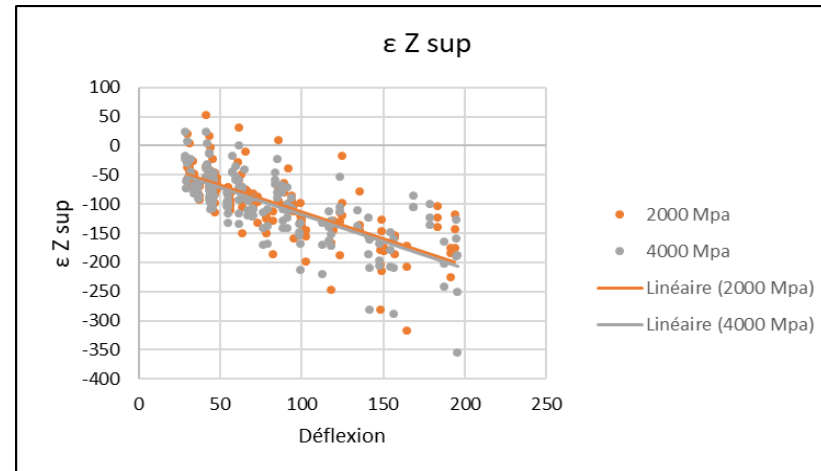
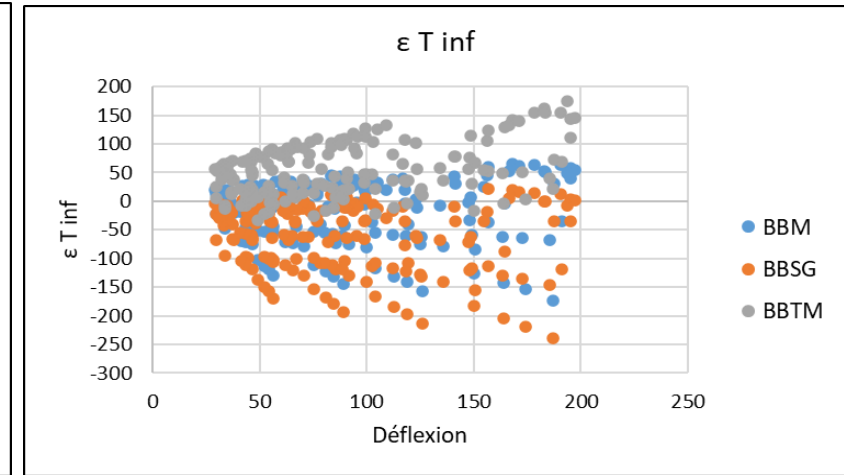
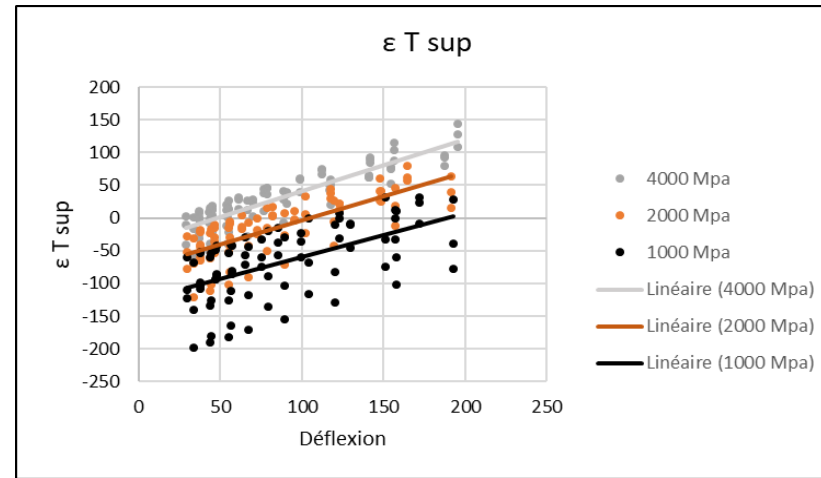
Loads on the surface and at  
 the base of the new CoR

Deflection basin  
 at 10 Hz

Alizé database: **780 calculations!**

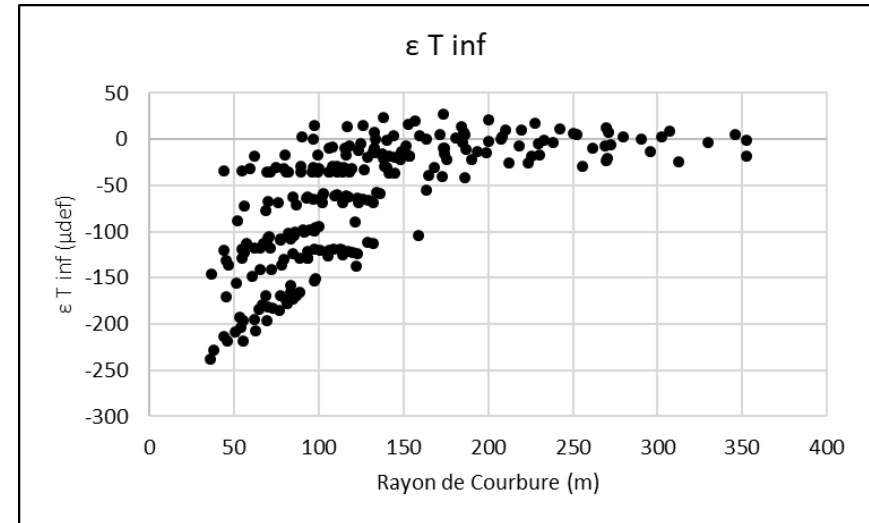
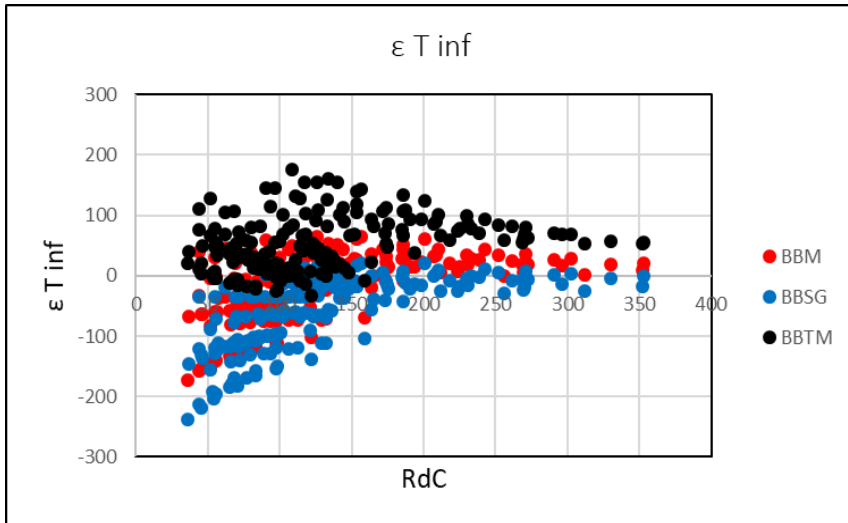
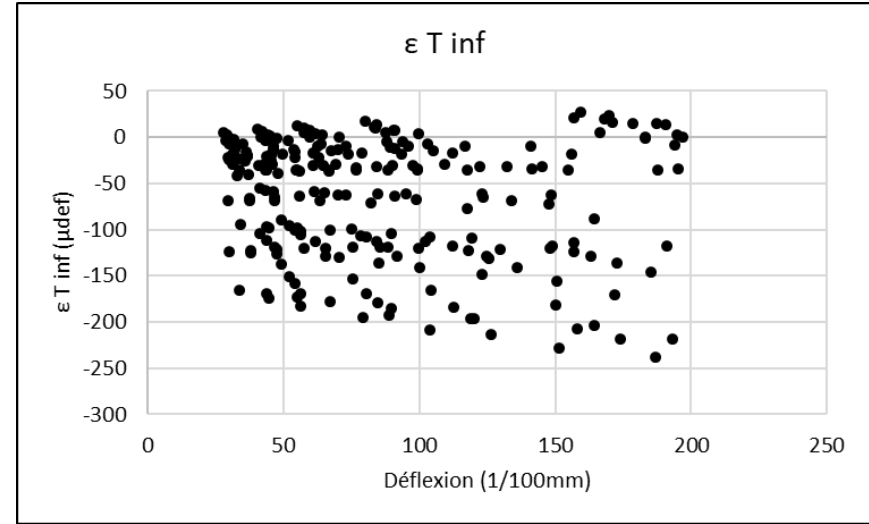


- Study of the influence of different database parameters on the relationship between structural stresses and deflection
- Significant CoR load values
- Differences in behaviour depending on the new wearing course

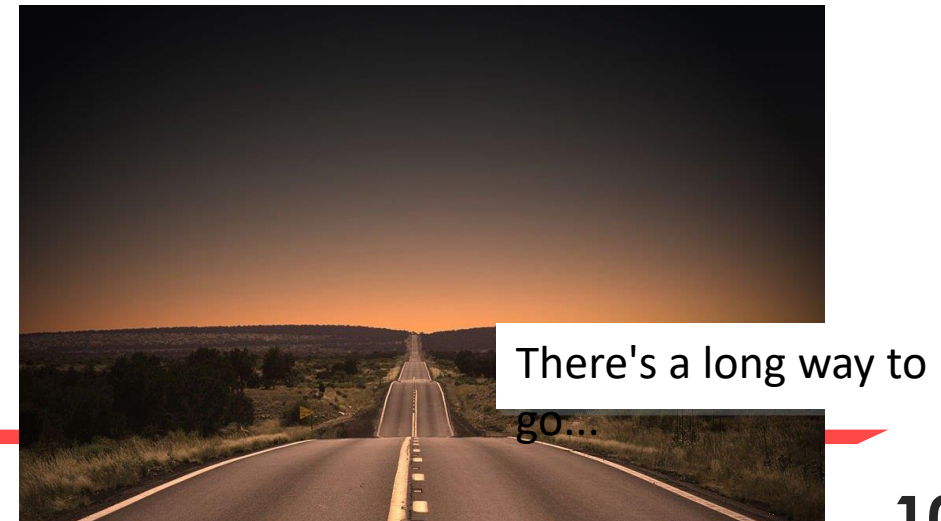




- The relationship between deflection and stresses is complex because it is multifactorial, which the ACTE guide does not take into account
- The bending radius allows a better understanding of the link "structural state" and "stresses in the structure"



- The ACTE guide is based on an empirical approach
- Create a database from ALIZE Lcpc calculations ⇒ highlighting compressive and/or tensile stresses that vary with deflection
- Bending radius could be a more reliable indicator for choosing wearing courses
- An approach based on a 4-point bending test with controlled deformations, using a procedure that still requires further thought.



Thank you for your attention

Contact: [donatien.delesquen@eiffage.com](mailto:donatien.delesquen@eiffage.com)

