



The Iso test track : COLAS Group's experience



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Outline

- **ISO test track :**
 - **Definitions**
 - **Standard ISO 10844 : Evolutions**
- **Mix design**
 - **Standard to mix design**
 - **Two microphones impedance tube**
- **Experiences of Colas group Since 2006**
 - **Sacer, Colas, Screg Subsidiary**
- **Conclusions**

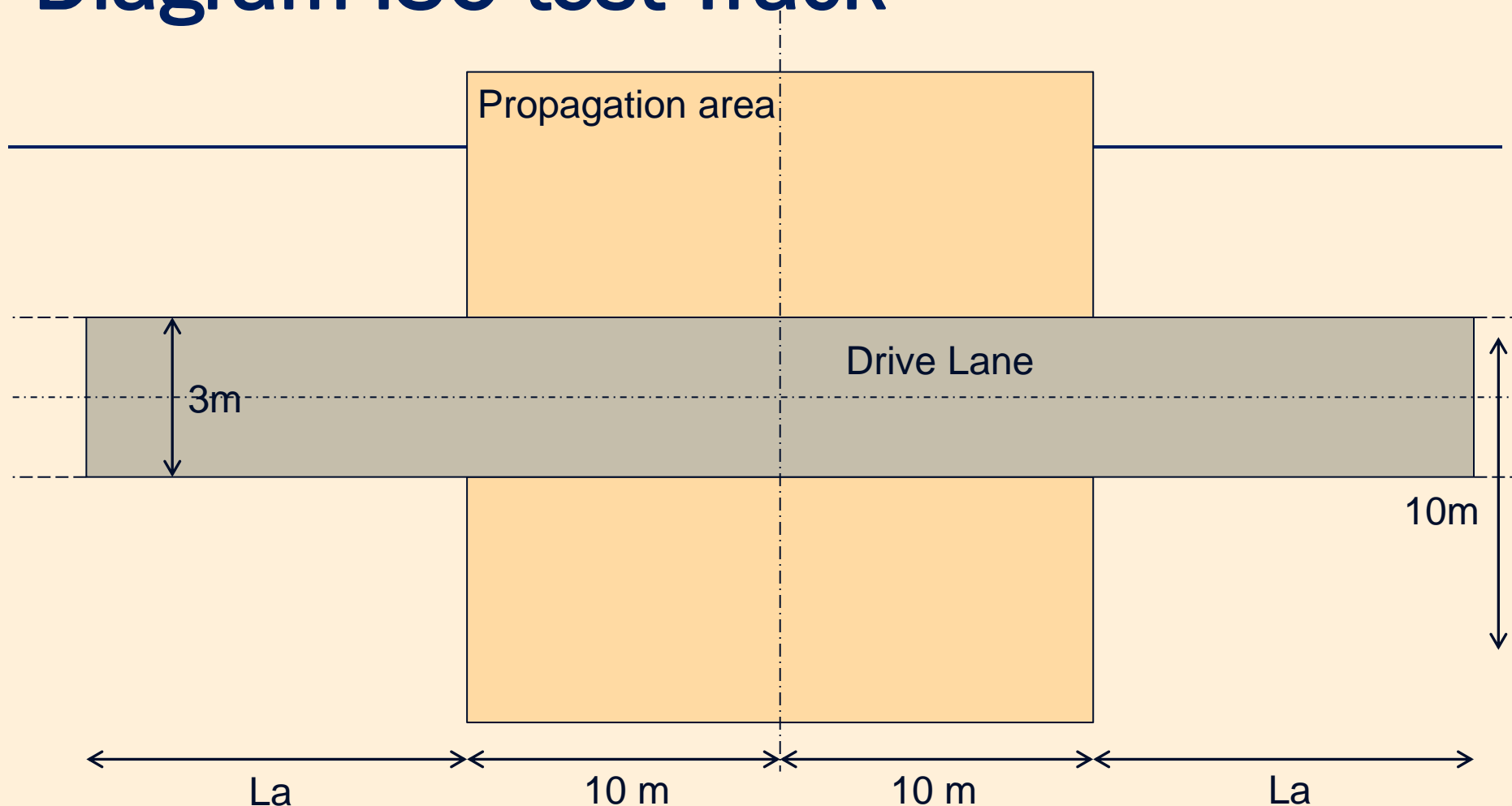
The Iso test track

- **Specific tracks : Standard ISO 10844**
 - **Characterize the noise emissions**
 - **Cars or trucks**
 - **Tires (tires manufacturers)**
- **Measurement of vehicle noises**
- **Same values between the different measurement sites**
 - **Very high level of specifications for a relatively small area**

Test track ISO 10844 standard: Evolutions

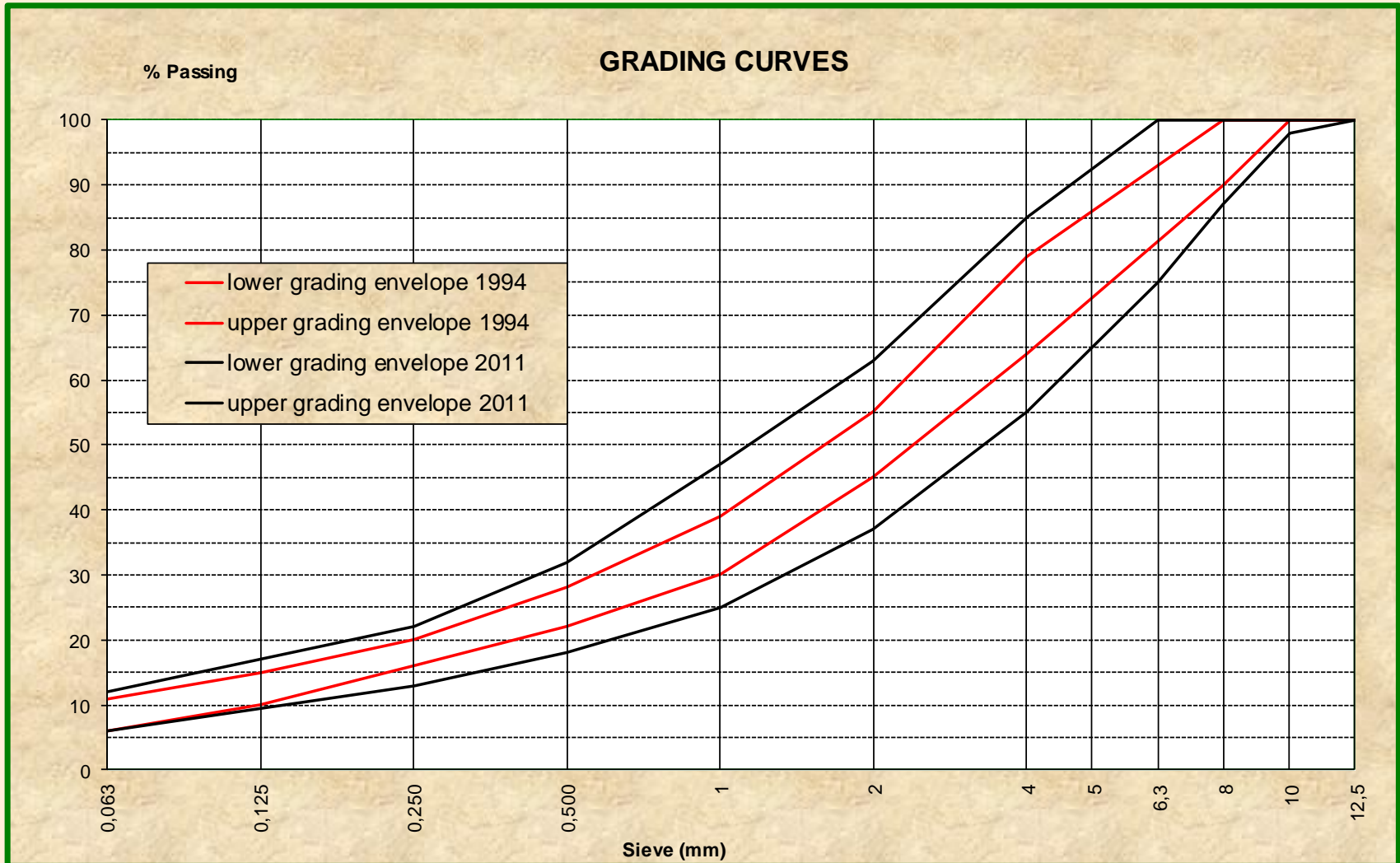
- **Dense Asphaltic concrete**
- **September 1994**
 - Straight bitumen
 - informative sieve
 - Voids content $\leq 8\%$ or $\alpha \leq 0.1$ on the 400-1600 Hz frequency (Core measurements)
 - Mean Texture Depth ≥ 0.4 (sand patch)
- **February 2011**
 - Modified binder allowed
 - $\alpha \leq 0.08$ on the 315-1600 Hz frequency (In situ Measurement)
 - Mean Texture Depth: Machine fulfilling ISO 13473-1 $0.5\text{mm} \pm 0.2$

Diagram ISO test Track



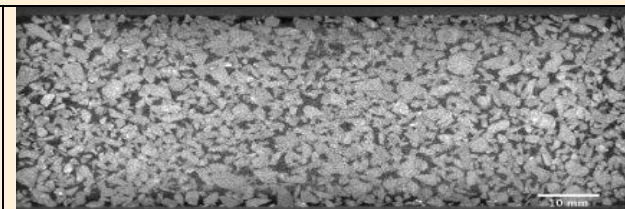
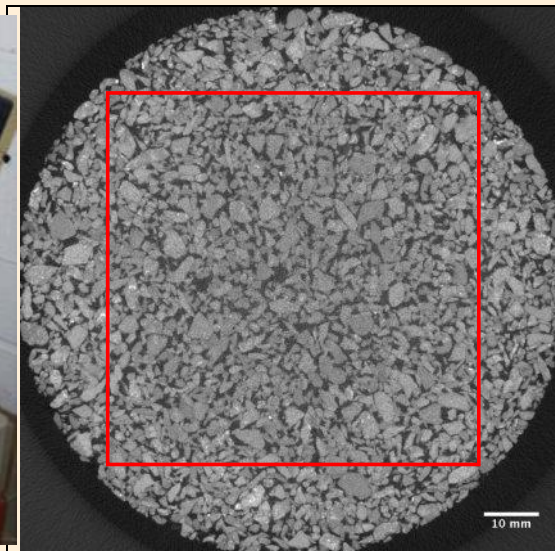
- Small size construction
- Geometrical parameter

Grading Curves

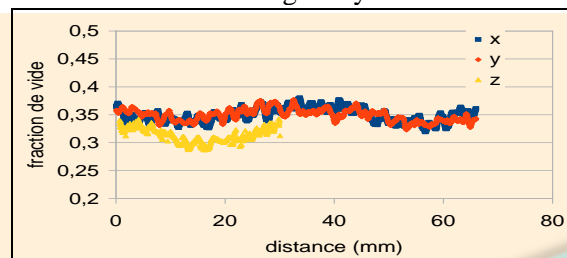


Mix Design

- **Standard to mix design**
 - Dense asphalt mix 0/6 to 0/10 mm
 - Rotary Shear Press (PCG 3 : EN 12697-10/ EN 12697-31)
 - Void content $\leq 8\%$ at V80
 - Acoustic Absorption measured by Impedance Tube
 - Specimens from Gyropac $\varnothing = 100\text{mm}$ (gyrator shear compactor)
 - Thickness : 30 à 55 mm

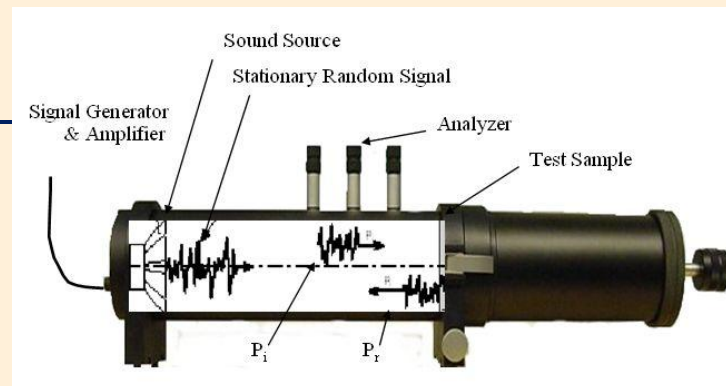


— Parallelepiped that forms the working volume for thresholding analysis



Impedance Tube

- **Two microphones**
Impedance Tube Method:
 - **Wideband sound signal, measure of acoustic pressure (FFT) and calculation of transfer function**
 - **Stationary random signal which is split into an incident acoustic pressure P_i and a reflected acoustic pressure P_r .**
 - **P_i & P_r are determined by relation between the acoustic pressures in a 2 microphones impedance device.**



Fonction de transfert entre les 2 microphones

$$H_{12} = \frac{P_2}{P_1} = \frac{e^{jkh} + R e^{-jkh}}{e^{jk(h+s)} + e^{-jk(h+s)}}$$

h : distance between micro-sample
k : wavenumber $\frac{2\pi}{\lambda}$
s : space between 2 micros

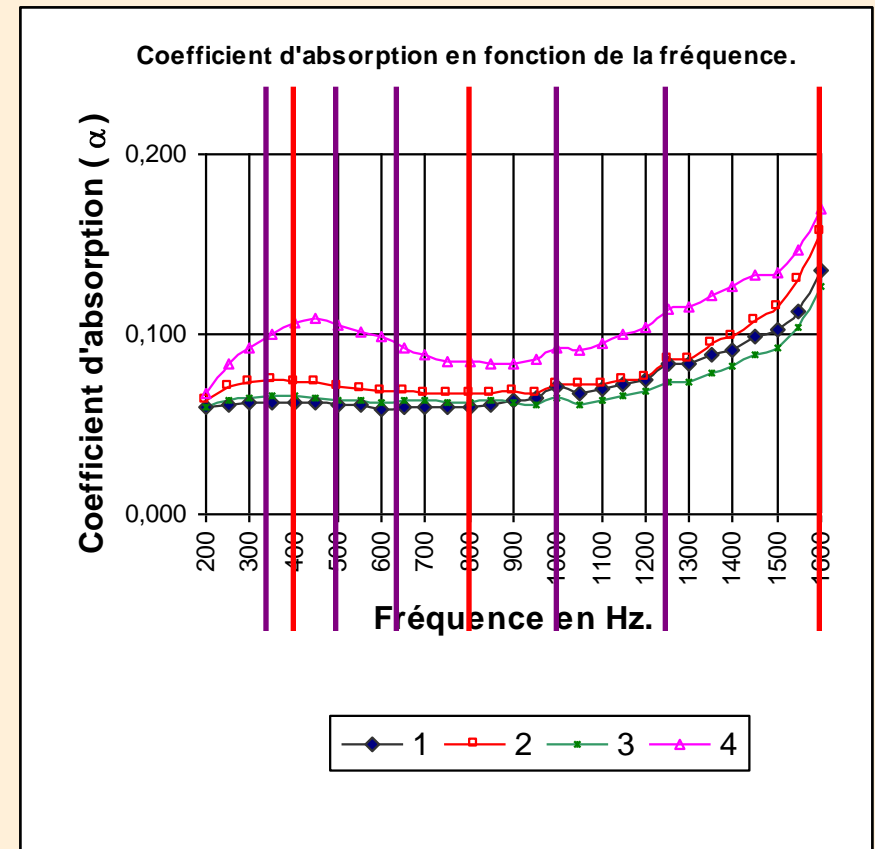
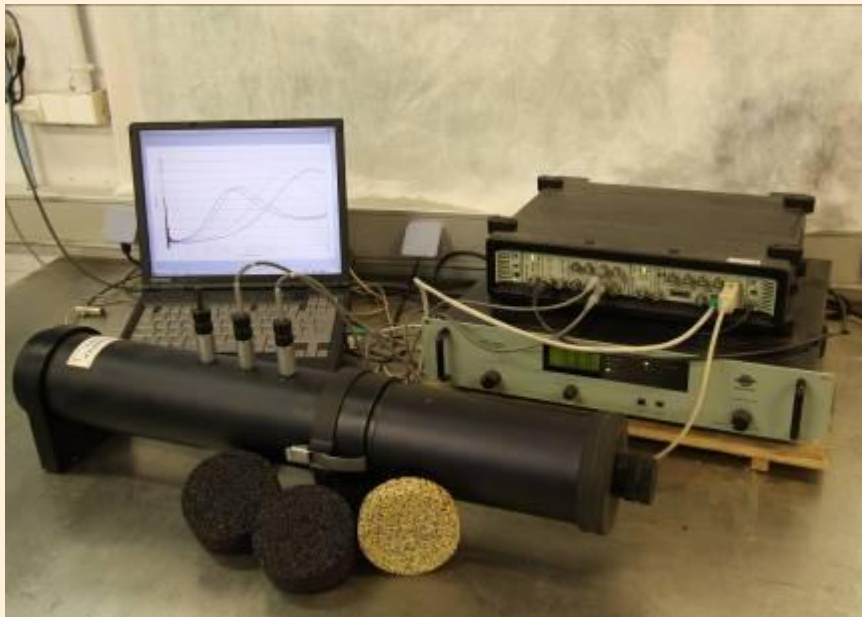
Reflexion Factor

$$R = \frac{H_{12} - e^{-jks}}{e^{jks} - H_{12}} e^{j2k(h+s)}$$

Absorption factor

$$\alpha = 1 - |R|^2$$

Impedance Tube on core samples



- **Used for ISO mix design**
 - Laboratory or core samples
- **Used for low noise asphalt mixes**

■ Different kind of fitting

Colas group experience Since 2006

- **2006-2007 : Sacer Sud Est Project**
- **8 different mixes studied in laboratory**
 - Sometimes outside from the envelope
 - ISO 10844 : 1994
- **Test sections on the acceleration and braking lane**
- **Extraction of core samples**
 - MTD, void content and absorption coefficient

Results Sacer Sud Est Project

- 2 kinds of compaction
- In situ measurements

	D		F		G	
Compaction mode	1	2	1	2	1	2
MTD	0,53	0,5	0,45	0,4	0,3	0,3
% voids	6,2	6,5	5,9	4,5	4,3	4,5
α (400-1600 Hz)	0,097	0,088	0,086	0,065	0,068	0,076

- Mix Design D
- Comply with the ISO 10844:1994

	Spec	Results	
Thickness	> 30 mm	15 core samples	Mean 38,8 mm
MTD	> 0,4 mm	12 measurements	Mean 0,66 mm
Void Content	< 8%	4 core measured	6,7%

Colas group experience Since 2006

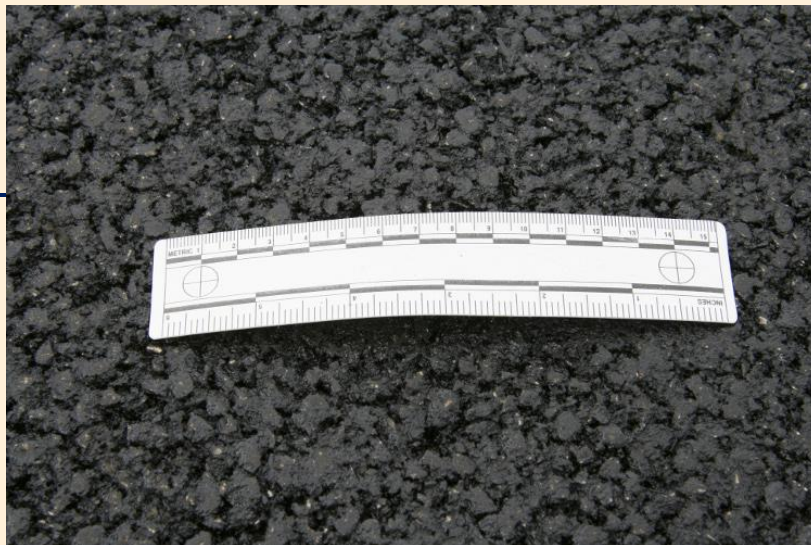
- **2008 : Colas IDFN Project**
- **3 mixes**
 - Sacer Sud Est mix, ISO Mix and outside from the envelope
 - ISO 10844 : 1994
- **Test sections on the acceleration and braking lane**
- **Extraction of core samples**
 - MTD, void content and absorption coefficient
- **Specifications :**
 - Void content & absorption coefficient
 - Using 10844:1994 and draft !!

2008 : COLAS IDFN

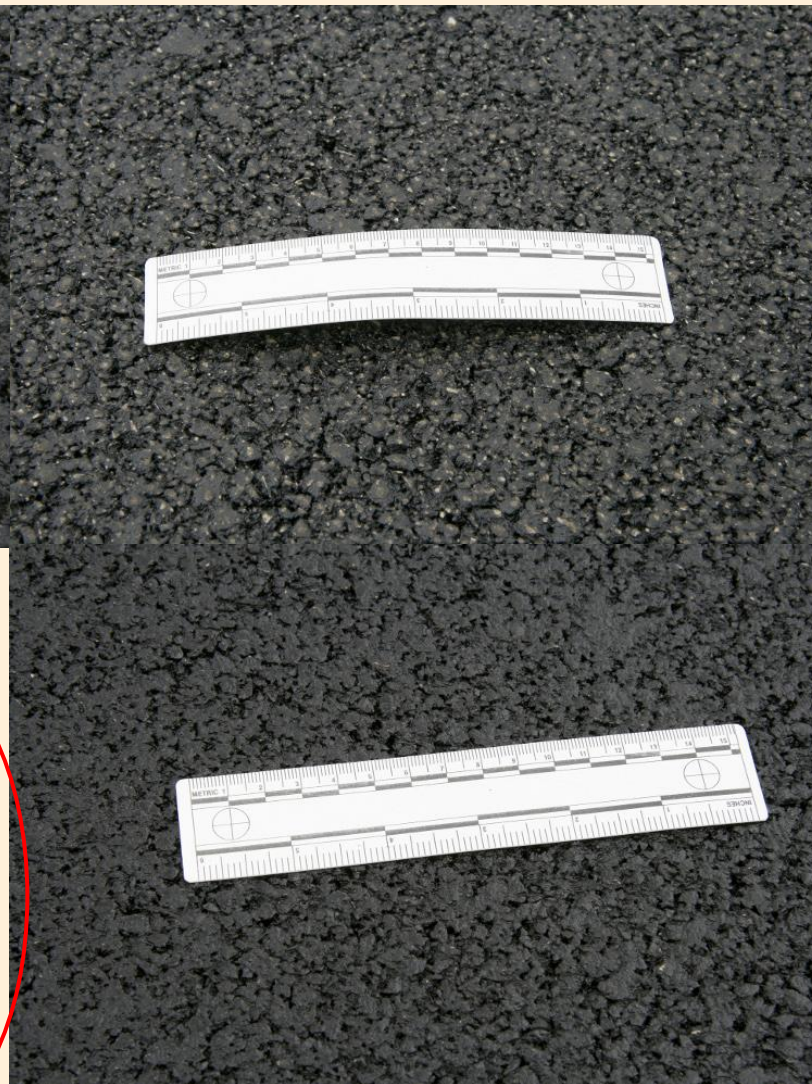
- Trial sections



C06



C03



C07

	C03	C06	C07
MTD (mm)	0,36	0,54	0,41
Void Content	2,4	3,5	6,5
α (400-1600Hz)	0,061	0,069	0,075

Colas group experience Since 2006

- **2009 : Screg Sud Est Project**
- **Mix design**
 - Local aggregate : problem with basaltic aggregate
 - High filler content sand
 - ISO 10844 : 1994
- **Trial sections allowed**
- **Extraction of core samples**
 - MTD, void content and absorption coefficient

Worksite Screg Sud Est Project



- **Drive lane and propagation area**

	F3	F4	F5	F6
α (315-1600Hz)	0,101-0,069	0,093-0,059	0,0113-0,055	
Void content		9,6	11,1	6,5
MTD		0,37	0,46	0,45
α (315-1600Hz)		0,077	0,089	0,058

Colas group experience Since 2006

- **2011 : Colas Rhône Alpes Project**
- **5 different mixes**
 - Local aggregates and specific aggregates
 - Sometimes outside from the envelope
 - ISO 10844 : 2011
 - Laboratory : acoustic measurement with Impedance tube
 - Selection of mix design
- **Test sections on the acceleration and braking lane**
- **In situ measurement**
 - MTD and absorption coefficient

In situ impedance tube ISO 10844:2011

- Selection of mix design with laboratory impedance tube
 - 315-1600 Hz
- Validation with In situ impedance tube
 - ISO 13472-2
 - **250 – 1600 Hz**



	F1	F2	F3	F4	F5
$\alpha(315-1600\text{Hz})$	0,091	0,098	0,083	0,102	0,139
MTD	0,29	0,32	0,37	0,4	0,54
$\alpha(250-1600\text{Hz})$	0,053-0,115	0,023-0,071	0,036-0,085	0,02-0,061	0,038-0,084

Conclusion

- **ISO test tracks:**
 - Small surface areas
 - Very technical with compromise between some criteria
 - MTD
 - Absorption
 - Preliminary work in laboratory
 - Trial sections recommended
- **Expertise of Colas group:**
 - 6 ISO test tracks since 2006
 - Recognized by several major vehicle and tire manufactures