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A METHODOLOGY TO EVALUATE PAVEMENT NOISE PERFORMANCES

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Context

- **Low noise pavements** can be used as **cost-effective means** of road traffic **noise reduction**
- **New efficient pavements** have been developed, showing **high noise reductions**
- **Lack of standard and reference procedure** for comparing pavements is an **obstacle** to the **compilation of experience and further development** of low noise pavements
- Contractors often face **difficulties to reproduce noise performances** of a given pavement type from one site to another

Context

- **Road authorities** want to introduce **noise requirements** in tenders for pavement renewal**.** They need **reference methodology** to **fix** the requirements and **check** on site their application

- In France, the **GNCDS** was tasked to develop and implement a **consensual method for characterisation & verification of pavement acoustical properties.**

What is GNCDS?

- National Group for Road Surface Characteristics
- Created in 1991 by the Road General Director
- 3 subgroups
  - Longitudinal uneveness
  - Texture and skidding resistance
  - **Noise**

What is GNCDS?

Objectives ?

- To define the **links** between the **quality of service** and the **technical requirements**
- To select appropriate **measurement methods**
- To publish **practical reference documents**
- To prepare **circulars** for the Road Administration

How does it work ?

- **Public/private partnership** (50% « administration » / 50% « industry »)
- **Exchange** of experiences, of opinions
- **Consensual production** (informative notes, papers, workshops…)

Current situation

- **Classification systems are currently active** in some EU countries
- **A classification method** for acoustic performances of road surfaces is **under discussion at CEN level**
- **A system** was proposed in the EU projects **« SILVIA »** and disseminated in **« INQUEST »**

The "SILVIA" system

- **Classification : ISO/SPB**
  - + CPX (for validation of SPB measurement spot and reference for further checking)
  - + Texture
  - + Sound absorption (porous pavements)
- **Checking Conformity of Production (COP) : CPX** after 2 months
  - + texture + sound absorption + others
- **Monitoring : CPX**

Classification

Reference measurement

Rolling noise by Statistical Pass-By (SPB)
(EN ISO 11819-1)

+

Rolling noise by Close Proximity (CPX)
(pr ISO 11819-2)

+

Texture spectrum (NF EN ISO 13473 **)**

+

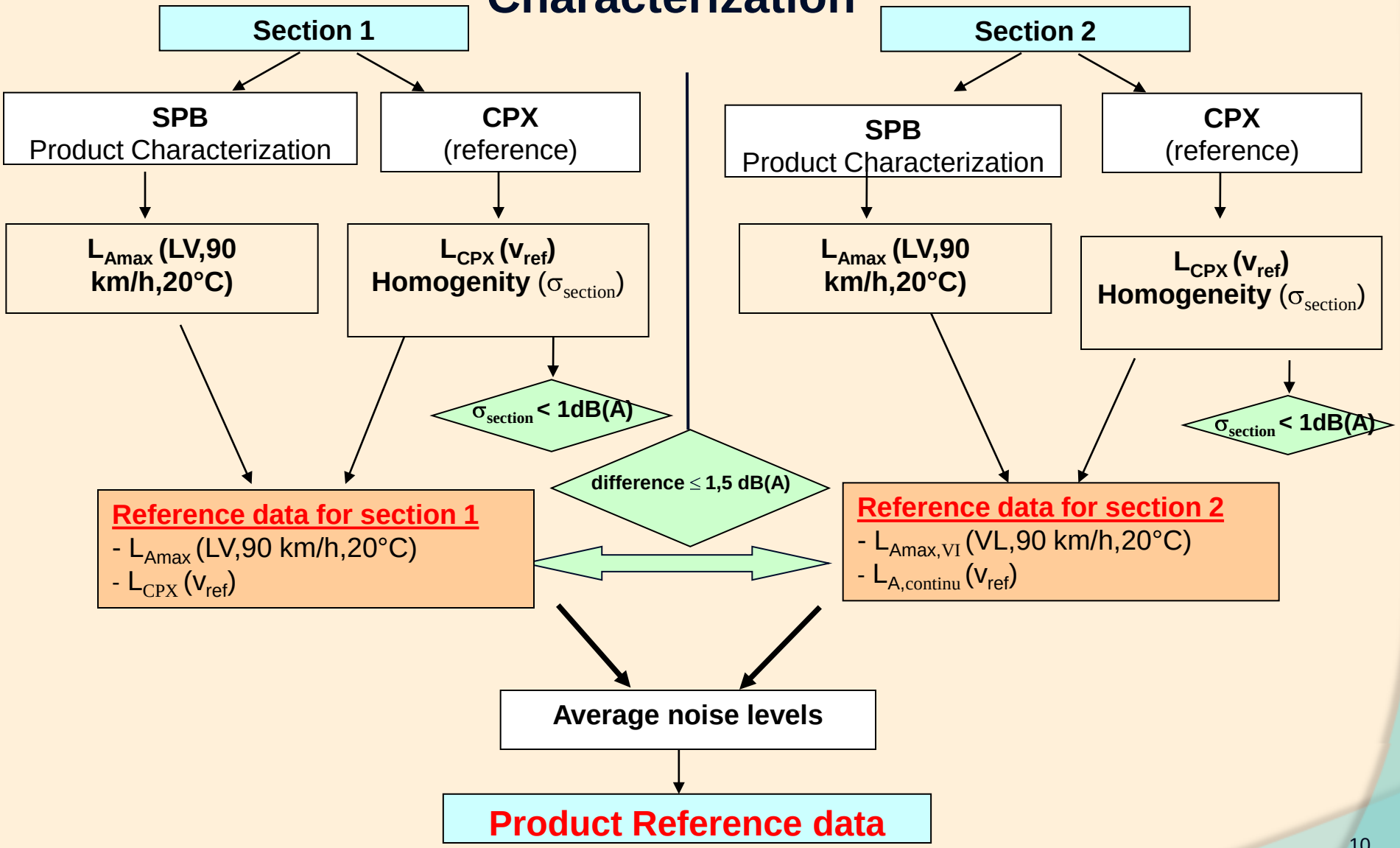
Sound absorption (for porous pavement)

(ISO 13472-1**)**

The French methodology

- **Based on the « SILVIA » procedure**:
  - **characterization** of pavement products (labelling) by SPB + other measurements
  - **checking** on site of pavement conformity by CPX
  - acoustic **monitoring** of pavement sections and networks by CPX
- **Simplifications and adaptation to local context** introduced: eg. 2 sites for labelling
- **Experimental validation**
- **Adaptation** according to the conclusions of the experiment

Characterization



Check of acoustic performances after works

- **Measurement of CPX noise level,** 2 to 3 months after opening to traffic and at a chosen reference speed **($L_{CPX(Vref)}$)**
- **Comparison of ($L_{CPX(Vref)}$) with the reference CPX level at the same speed obtained during the characterisation test ($L_{CPX(Vref)\ caract}$)**
- **The road surface is accepted if :**

$$(L_{CPX(Vref)}) \leq (L_{CPX(Vref)\ caract}) + Y$$

with tolerance Y = 2 dB(A)

- Y is due to the **reproducibility** of the **measurement**, the **mix design** and the **laying procedure**

Experimental validation : principles

- ✓ **3** road companies
- ✓ **1** low noise product per company : E_i
- ✓ Very Thin layer 0/6 class 1 or 2 « low noise » (proprietary) products
- ✓ **2** sites per product : S_{iA}, S_{iB}
- ✓ Assessment distributed in **5** different teams : L_1 to L_5

Experimental validation : sites

Prod.	Sites	Speed limit (kph)	Age of surface
P1	S_{1A}: Single carriageway urban ringroad	90	3 Y
	S_{1B}: Single carriageway interurban road	90	2 Y + 10 M
P2	S_{2A}: Dual carriageway urban ringroad	70	8 M
	S_{2B}: Dual carriageway urban ringroad	110	3 Y + 4 M
P3	S_{3A}: 3-carriageway motorway	130	7 M
	S_{3B}: Dual carriageway interurban highway	110	14 M

Note : reference speed for noise measurements : 90 kph

Reference measurement

Rolling noise by Statistical Pass-By (SPB)
(EN ISO 11819-1)

+

Rolling noise by Close Proximity (CPX)
(pr ISO 11819-2)

+

Texture spectrum (NF EN ISO 13473 **)**

+

Sound absorption (for porous pavement)

(ISO 13472-1**)**

Experimental validation: results

Road surface Prodct	Sites	Speed limit (kph)	Age when meas[d] (yrs)	SPB			CPX			
				Lab	Avg traffic speed (kph)	L_{SPB}(90 kph) (dB(A))	Lab	Speed (km/h)	Section length (m)	L_{CPX} (90 kph) (dB(A))
E_1	S_{1a}	90	3	L_1	87	**73.0**	L_2	90	300	**94.2**
	S_{1b}	90	2.8	L_1	79	**72.2**	L_2	90	620	**93.8**
						Δ_{SPB} = -0.8				**Δ_{CPX} = -0.4**
E_2	S_{2a}	70	0.7	L_2	78.5	**72.0**	L_2	50	700	**94.1(*)**
	S_{2b}	110	3.3	L_1	107	**75.6**	L_3	90	3000	**96.4**
						Δ_{SPB} = 3.6				**Δ_{CPX} = 2.3**
E_3	S_{3a}	130	0.6	L_1	114	**74.3**	L_2	90	4400	**96.3**
	S_{3b}	110	1.2	L_1	91	**76.1**	L_2	90	1400	**95.4**
						Δ_{SPB} = 1.8				**Δ_{CPX} = -0.9**

Experimental validation: conclusions

- ✓ **At least 2 sections, 100 m long minimum**
- ✓ Sections with pavements of **similar age** (difference ≤ 1yr)
- ✓ Test sites must allow an **average measurement speed of SPB (*i.e. average speed of the traffic flow*)** close to the chosen **reference speed.**
- ✓ Test sites must allow **CPX measurements at all speeds within the speed range of use of the road surface**
- ✓ **Acoustic performances (SPB) of sections must not be more than 1.5 dB(A) different**

Application

Application of the methodology by the 3 road companies, following the new essential requirements

Road surf. Prod.	Sites	Age (years)	SPB		CPX		Final ref. values		
			L_{SPB} (90 kph) (dB(A))	$\Delta_{a,b}$ dB(A)	L_{CPX} (90 km/h) (dB(A))	homogeneity σ (dB(A))	L_{SPB} (90km/h) (dB(A))	L_{CPX} (90 km/h) (dB(A))	$\Delta_{SPB/CPX}$ **(dB(A))**
P_1	S_{1a}	< 1	69.5	1.4	93.2	n.d.	**68.8**	94.2	**25.4**
	S_{1b}	< 1	68.1		95.1	0.95			
P_2	S_{2a}	< 1	69.6	0.1	95.6	0.48	**69.5**	95.3	**25.8**
	S_{2b}	4	69.9		93.7	0.83			
	S_{2c}	< 1	69.5		95.1	0.74			
P_3	S_{3a}	< 1	72.4	0.7	97.0	0.33	**72.7**	96.2	**23.5**
	S_{3b}	< 1	73.1		95.5	0.42			

Conclusions

- ✓ **It is difficult for road contractors to reproduce noise performances for a given pavement type**
- ✓ **Variations in SPB noise levels lower than 1.5 dB(A) are possible, provided some precautions are taken:**
  - ✓ Average traffic speed close to the measurement reference speed,
  - ✓ The 2 sections to be characterised should be at least 2 month old but no more than 1 year difference between them
  - ✓ It is recommended that the same operator performs the measurements on both sites

Conclusions

- ✓ **Sound absorption can't be easily evaluated in practical situations.**
- ✓ **The analysis of measured texture spectra did not lead to a meaningful interpretation, in particular regarding the END_T indicator proposed in "SILVIA"**
- ✓ **The methodology presented here proved to be operational and consensual but still needs to gain more experience**

Thank you
for your attention !

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