Introduction — Environmental Noise Directive

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| STAGE 1: \*
| Major Noise \*: more than 80 dB(A) measured |
| Major Roads \*: more than 15 million vehicle-kilometres per year |
| Major Railways \*: more than 1.5 million train-kilometres per year |
| Major Airways \*: more than 50,000 movements per year |
| ROSE MAPPING \*: 30 June 2007 |
| ACTION PLANNING \*: 31 July 2008 |

STAGE 2: \*
| Major Noise \*: more than 75 dB(A) measured |
| Major Roads \*: more than 10 million vehicle-kilometres per year |
| Major Railways \*: more than 1 million train-kilometres per year |
| Major Airways \*: more than 30,000 movements per year |
| ROSE MAPPING \*: 30 June 2012 |
| ACTION PLANNING \*: 31 July 2013 |

Tyre/Road Noise in Total Noise Emission
Common, dense-graded surface layers (AC, SMA)

Mechanisms of the Tyre/Road Noise Generation
- Tyre rotation
- Vibrations in the tyre

Mechanisms of the Tyre/Road Noise Generation
- Air pumping
Mechanisms of the Tyre/Road Noise Generation

- Horn effect

Optimisation of Noise Reduction Performance

Two Main Types of the Open Surface Shape

- Positive shape
- Negative shape

Optimisation of Noise Reduction Performance

- Using a small maximum aggregate size of 5.6 mm to achieve an even and smooth pavement surface that could reduce noise generated from vibrations in the tyre.
- Using a high void content to achieve an open surface texture that can reduce noise generated from air pumping. The target void content is about 5–6%.
- Using cubic aggregate to achieve an even and smooth pavement surface that can reduce noise generated from vibrations in the tyre.
- Using a low sand content to achieve a highly open porous surface texture and dense structure of the layer.

Analysis and evaluation of surface texture parameters

- Optical 3D measurement analysis

Optimisation of Noise Reduction Performance

Acoustically Relevant Surface Texture Parameters

- Mean profile depth, MPD, and estimated texture depth, ETD
Optimisation of Noise Reduction Performance
Acoustically Relevant Surface Texture Parameters

- Maximum amplitude of the wavelength spectrum, $A_{\text{max}}$
- Wavelength corresponding to the maximum amplitude, $W_{\text{max}}$

Analysis and evaluation of surface texture parameters — Graphical Output Examples

Mastic Asphalt, MA 8 S  Shape factor, $g = 45\%$

Noise Measurements on the Test Pavements
Close-Proximity (CPX) Measuring Method

CPX measuring trailer with the towing vehicle
Noise Measurements on the Test Pavements
Close-Proximity (CPX) Measuring Method

Position of the microphones near the reference tyre

Noise Measurements on the Test Pavements
Noise Emission Development over Time

Noise Measurements on the Test Pavements
Comparisson of the Acoustical Properties of LOA 5 D with Other Surface Layers

Light vehicles at 50 km/h

Heavy vehicles at 50 km/h

Recommendation of the Specification for LOA 5 D

Construction materials
Percentage of coarse aggregate in stone mastic
Resistance to fragmentation of coarse aggregate
Resistance to polishing of coarse aggregate for asphalt mixtures
Class of bitumen
Mixture composition
Percentage by mass passing 8 mm sieve
Percentage by mass passing 5.6 mm sieve
Percentage by mass passing 2 mm sieve
Percentage by mass passing 0.125 mm sieve
Bitumen content by volume
Minimum void content
Maximum void content
Minimum voids filled with bitumen
Maximum voids filled with bitumen
Resistance to permanent deformation
Crush test for pavement stabilizer
Bituminous binder:
Composition of asphalt
Grain size distribution

Thanks for your attention!