



Laboratory Design of Quieter Asphalt Surfaces

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November, 2015



Introduction

- Develop laboratory procedures to measure noise generated by surfacing materials.
- Low-noise pavement surfaces are a cost-effective option to reduce traffic noise.



PFC



TOM



Introduction

- **Permeable Friction Course PFC**
 - Percent of air voids is at least 18 percent
 - Designed to achieve good drainability
- **Thin Overlay Mixture TOM**
 - Non-structural preventive maintenance
 - Can be laid at 1.0 to 0.5 inches thick and consist of quality aggregate and binder materials
 - Minimum asphalt content of 6.0 or 6.5 percent



Highway Traffic Noise

Tire-Pavement Noise

Pavements in noise mitigations.



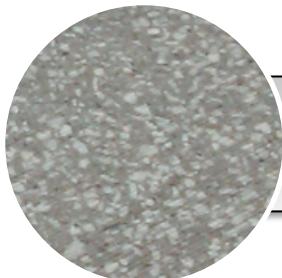
**Flexible
Pavement**

Surface
Texture

Surface
Porosity

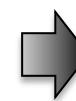
Surface
Stiffness

Other
Factors



**Rigid
Pavement**

Surface
Texture



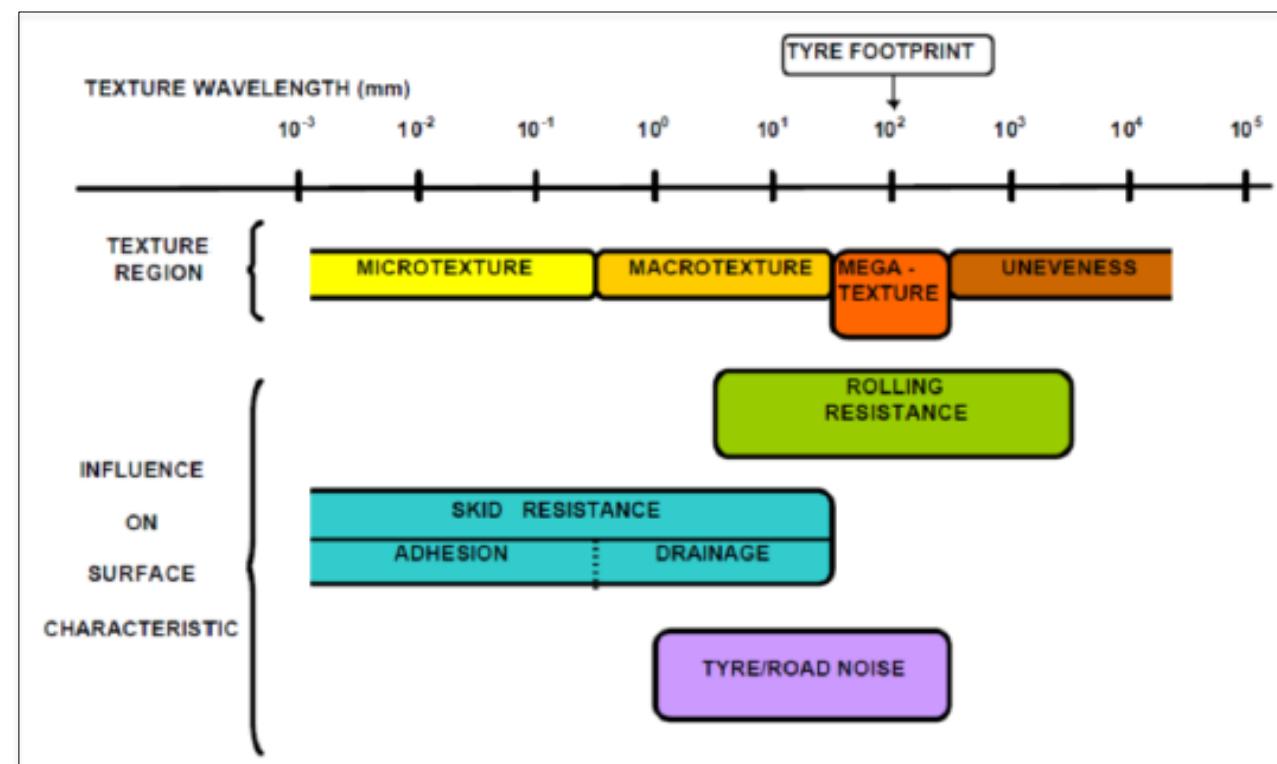
Finishing



Tire-Pavement Noise

Surface texture

- Both macrotexture and megatexture influence in road noise.
- Macrotexture is mainly influenced by:
 - Gradation
 - Degree of compaction

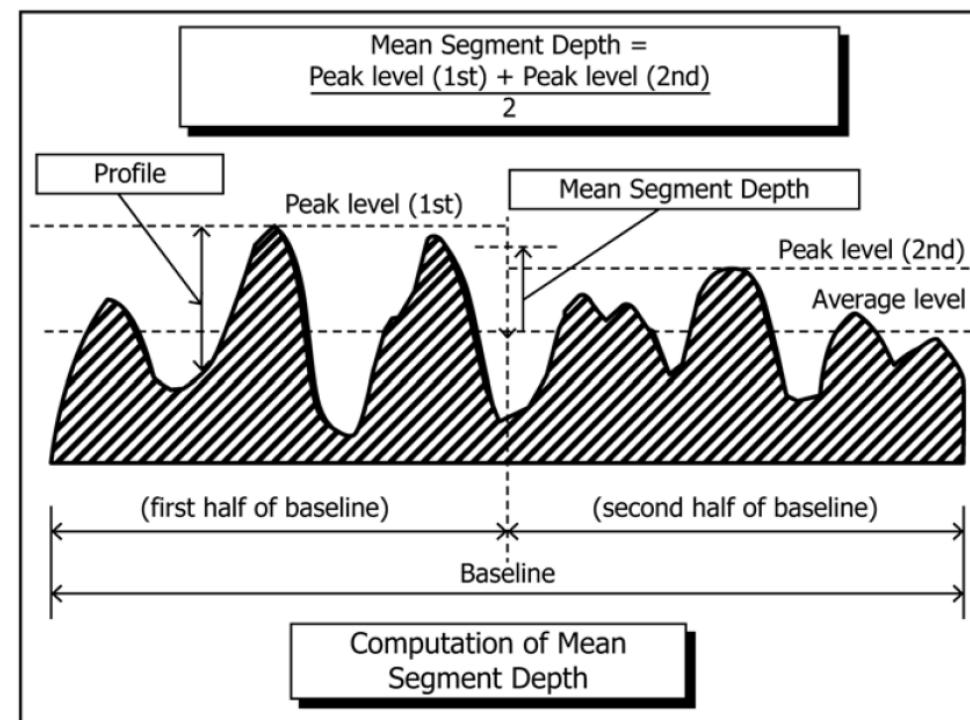




Tire-Pavement Noise

Macrotexture

- Mean Profile Depth
MPD - ASTM E1845
- MPD is the average value of the mean segment depths for all segments of the measured profile



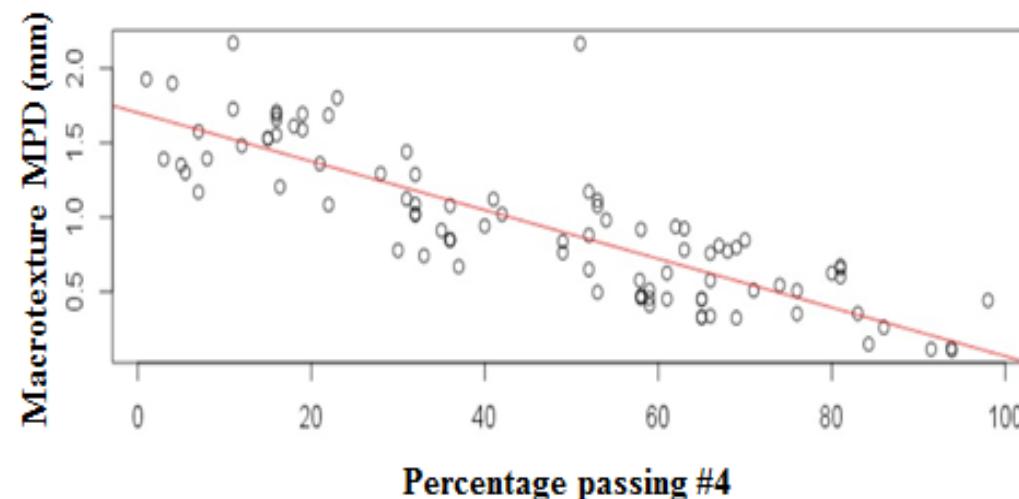


Tire-Pavement Noise Macrotecture and Gradation

- Noise database from data collected on asphalt pavements tested in Texas and at the National Center for Asphalt Technology (NCAT) test track.
- The results of the statistical analysis suggest that to reduce noise, the design should focus more on producing mixtures with reduced macrotecture.
- Adjusting the gradation of the mixture may have a significant effect on noise production, but this effect may not be of practical significance and the effect is minor compared to that of macrotecture.

Tire-Pavement Noise Macrotecture and Gradation

- The best correlation was found between MPD and percentage passing the #4 sieve (4.75 mm).
- This relation provides a simple estimation of surface macrotecture in terms of mixture gradation and suggests an increase for coarser mixes and a decrease as the fines in the mix increase.



$$\text{MPD} = 1.7 - 0.0164 * P4$$



Laboratory Procedure

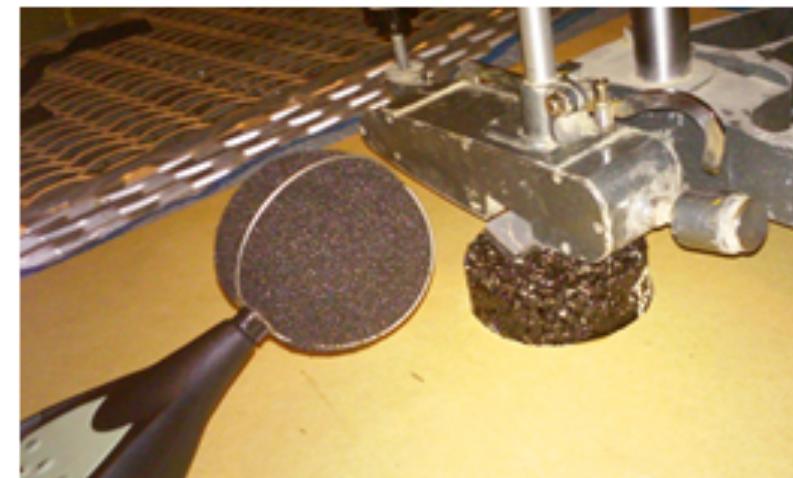
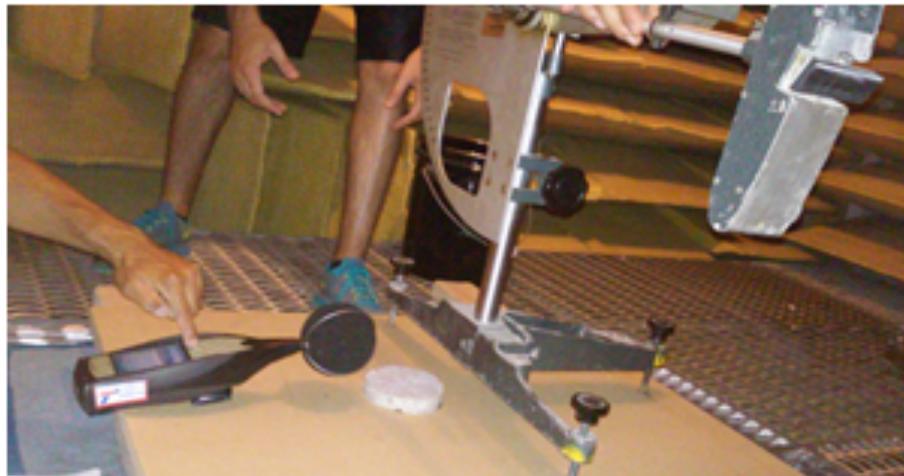
Test implementation

- Developed specifically to allow the design of quieter pavement surfaces in the laboratory before applying these in the field.
- Modification of the standard ASTM E303 procedure: Measuring Surface Frictional Properties Using the British Pendulum Tester (BPT).
- Process similar to wayside noise measurements.
- A sound pressure level meter is placed 4 inches from the contact of the rubber slider and the surface, and 3 inches above the surface of the specimen.



Laboratory Procedure

Test implementation

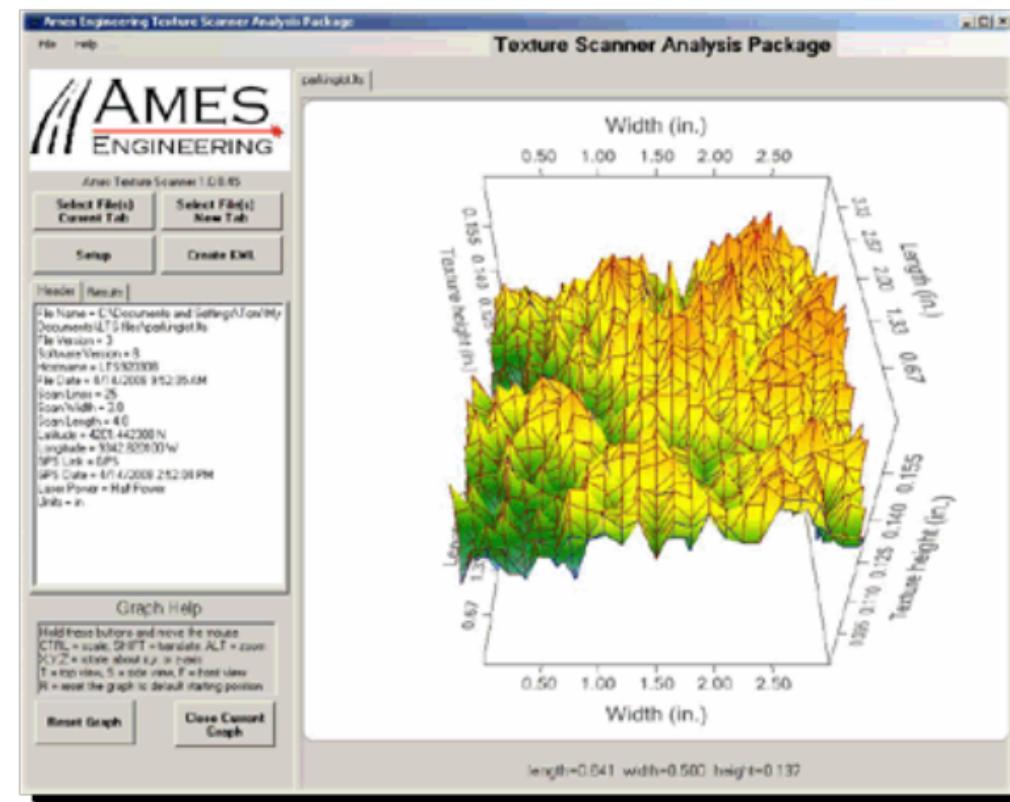


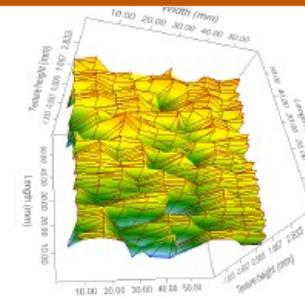


Laboratory Procedure

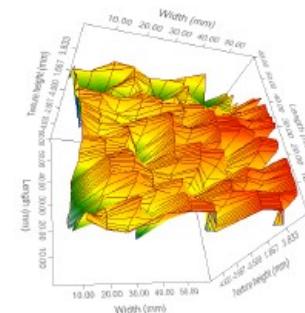
Macrotexture Measurement

- Laser Texture Scanner LTS

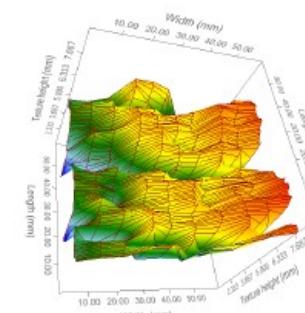




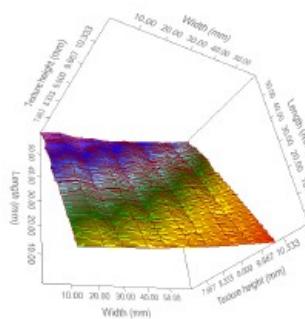
a) TOM
MPD: 0.578 mm
Noise: 83.7 dBA



b) PFC
MPD: 2.010 mm
Noise: 84.2 dBA



c) Concrete pavement
transverse tinning
MPD: 1.001 mm
Noise: 91.9 dBA



d) Concrete
Smooth surface
MPD: 0.038 mm
Noise: 88.5 dBA



Laboratory Test Results

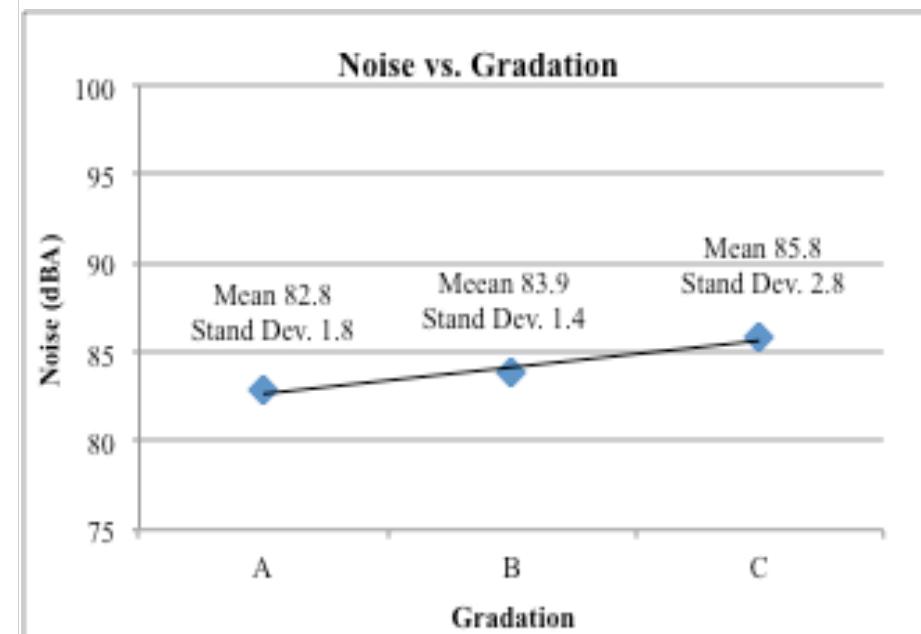
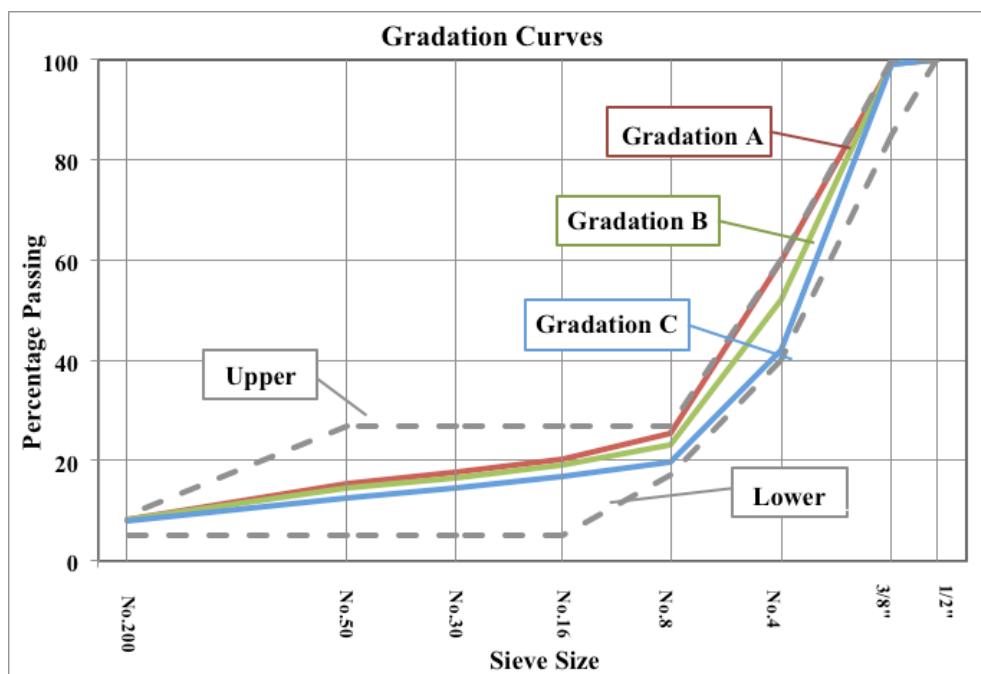
- Samples of Texas gyratory compacted TOM specimens were fabricated.
- Mixture related parameters were varied to observe its influence in noise generating.





Laboratory Test Results

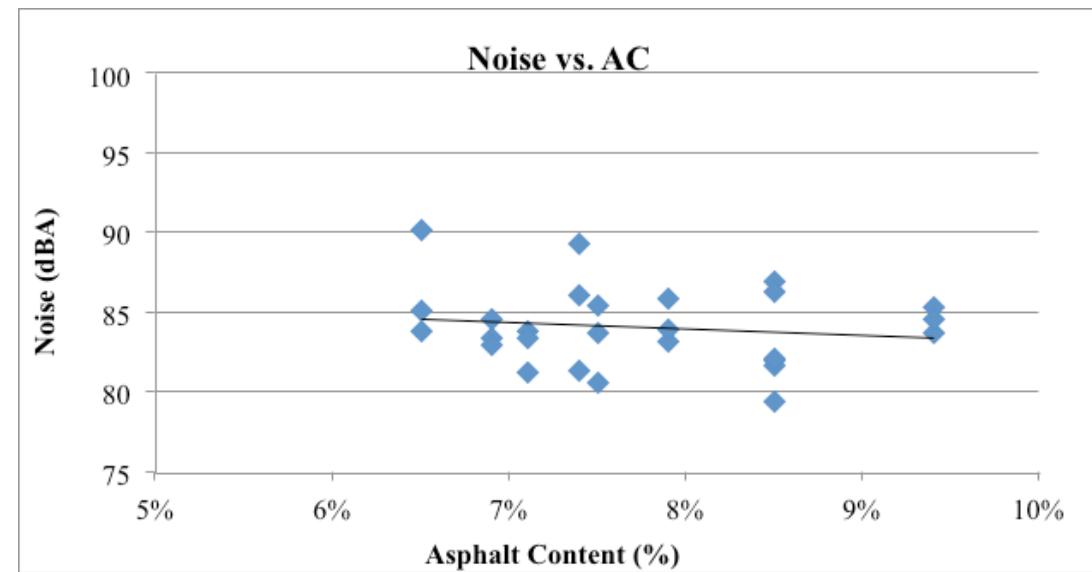
- Gradation influence



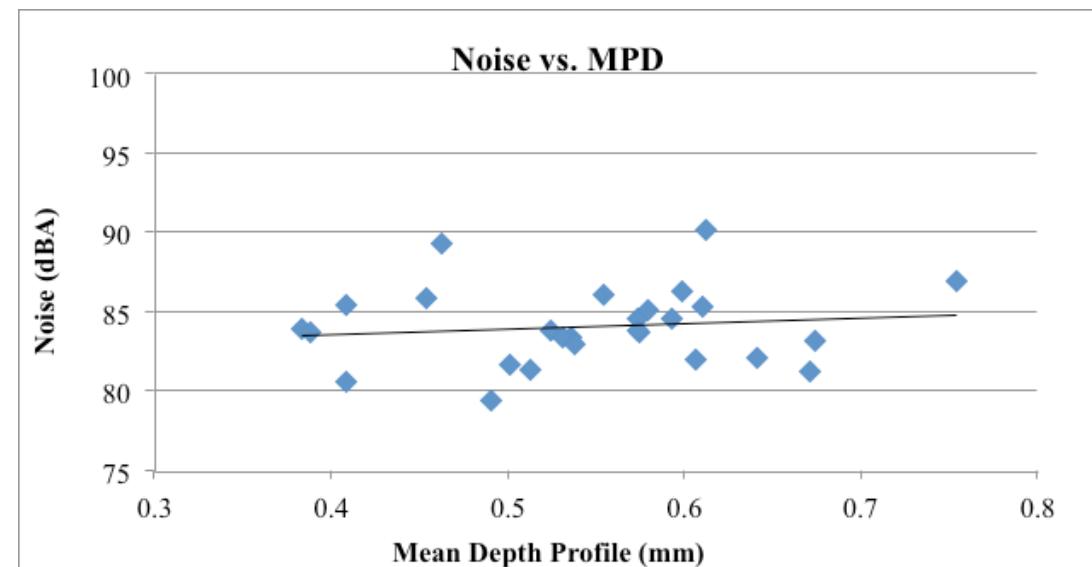


Laboratory Test Results

- Asphalt Content



- MPD





Conclusions

- With the test implemented it was possible to accurately measure noise in different type of surfaces and provide a repeatable and standard procedure that can use laboratory compacted samples and field cores, which allows further field validation.
- PFC has been the low noise mixture of choice. However, evidence from field trials indicates that PFC mixtures in Texas become significantly louder with time.
- TOM has a proven record of excellent performance as a surface overlay mixture in Texas. In contrast to PFC, noise in TOM mixtures is not overly sensitive to variations in aggregate gradation or asphalt content.



Thank you