AASHTO/FHWA
International Scanning Project

QUIET PAVEMENT SYSTEMS

SUMMER 2004
SCAN TEAM - Affiliation

- AASHTO & FHWA
- American Concrete Pavement Association
- International Grooving and Grinding Association
- National Asphalt Pavement Association
- Rubber Pavements Association
- Purdue University
- University of Texas
- Volpe Center
INTRODUCTION

Why a “quiet pavement” scan?

- Highway noise is a growing issue with the public.
- The public is demanding “quieter” pavements.
- We are a victim of our own success.
- Opportunity to learn from the European experience.
Countries Visited!
SCAN OBJECTIVES

- Discover and document state-of-the-practice European technology for quiet pavement systems
- Identify and recommend successful European quiet pavement technology systems for application in the U.S.
- Evaluate applicable noise measuring and monitoring systems
TOPICS OF INTEREST

Quiet Pavement Systems:

- Noise Policies
- Noise Reduction Programs
- Quiet Pavement Design
- Quiet Pavement Construction
- Quiet Pavement Maintenance
- Noise Analysis and Monitoring
- Quiet Pavement Research
EUROPEAN COMMON ISSUES

• Highway noise is a common concern

• The European Union Directive requires:
  - the development of 10-year plan
  - noise mapping (major roads and urban) (2007)
  - uniform prediction methods within Union
  - inclusion of rural areas
  - information be made available to public
  - adopt action plans (2007)
EUROPEAN NOISE POLICY

Key Findings:

- All countries visited:
  - Regard noise as a significant annoyance
  - Have noise legislation or a policy in place
  - Have established maximum or target noise levels (55-65 dBA)
  - Are working to meet the EU Directive
  - Are using or are developing quiet pavements

- Several countries are using:
  - Surveys to determine annoyance levels
  - Noise characteristics in pavement selection process
• Must mitigate to an absolute level, using many noise abatement measures
• SPB methodology for defining noise reduction
• Approximate pavement benefit of 5 dB (2PA)
• Quiet pavements included in prediction model
• Pavement noise reduction correlates well with pavement texture
• Approximate pavement benefit of 3.5 dB (1PA) and 6 dB (2PA)
ROADS TO THE FUTURE – Noise Reduction

Modieslab
6-7 dBA

Rollable Road
6 dBA

Adhesive Road
6 dBA

Silent Sound Module – 5dBA

100 km/h; Reference is DAC; SPB - Method

Photos: Jasper van der Kooij (DWW) & Gijsjan van Blokland (M&P)
• Quiet pavements benefits not sufficiently defined (choose traditional abatement measures)

• Substantial modeling research to understand tire/pavement interaction and sound propagation

• Approximate pavement benefit of 5 dB (1PA); by adding 1-2% rubber to binder, increase noise benefit ~1 dB
ITALY

- Minimum 7% of total road budget to noise reduction
- Acoustical absorption measurements included in pavement analysis
- Approximate pavement benefit of 3 dB (1PA) and 10 dB (SIRUUS)
• HAPAS – safety, durability, and noise reduction requirements
• Investigating CPX (with absorption) to predict SPB (wayside)
• Approximate pavement benefit of 5-6 dB (1PA) initial and 3 dB (after 8 years)
QUIET PAVEMENT DESIGN

Key Findings:

- The quiet pavement technologies being proposed in Europe today include: thin asphalt surfaces, highly porous asphalt surfaces (single & double layers), and exposed aggregate concrete pavements.
- Noise reductions of 3-9 dBA are being achieved with these pavements.
- Safety (skid) has been maintained or enhanced with these low noise surfaces.
- Porous asphalt surfaces (single & double layers) are more effective (noise reduction) on high-speed roadways.
- Exposed aggregate concrete has been used successfully to reduce noise (two countries)
Key Findings (cont.):

• Small aggregate sizes (0/5, 0/6, 0/10 mm - using a thin gap graded mix) are being used for low noise pavements in low to medium speed applications.

• Durability (pavement life) of low noise pavements vary depending on the pavement system and the experience of the highway agency (single layer: up to 15 yrs & double layer: 6-7 yrs).
Key Findings:

- A substantial amount of noise modeling research has been performed in Europe.
- Quiet pavements are being incorporated into noise models.
- Various noise measuring methods are being used in Europe, including:
  - Statistical Pass-By (SPB)
  - Controlled Pass-By (CPB)
  - Close Proximity Method (CPX)
  - Modified CPX
  - Sound Absorption
- All countries are using SPB, but some reporting only light vehicles.
NOISE ANALYSIS

Key Findings (cont.):

• Use of the CPX varies among countries (includes on vehicle method) and continues to be researched.

• The most important frequency range to address is 800-1500 Hz.

• Texture and porosity of pavements are important characteristics. However, there is no good correlation between permeability and noise reduction.

• Pavement texture degradation seems to have the most effect on lowering noise reduction capabilities.
QUIET PAVEMENT CONSTRUCTION

Key Findings:

• Pavements must be in relative good condition (underlying structure) before using porous asphalt surfaces.
• Conventional construction equipment can be used for the construction of quiet pavements.
• Major differences in contract administration in Europe. Moving to “low and best” bid. Design-build-maintain contracts are common.
• Gradual move to performance based specifications. A warranty is associated with most work, but not noise levels.
• No construction acceptance test for noise. Noise performance is based on test section or past experience.
QUIET PAVEMENT MAINTENANCE

Key Findings:

- Clogging continues to be an issue on low speed porous pavements (<45 mph).
- There is no consensus on the need for cleaning (high-pressure wash) and vacuuming of porous pavements.
- Winter maintenance of porous pavements has been addressed by pre-wetting and an increased salt application rate (25-50%).
- Porous surfaces fall to the frost point earlier than dense surfaces.
- No apparent maintenance concerns were identified with exposed aggregate concrete pavement.

Photos: Stefan Sigurdsson, Ministry of Transport and Public Works - Denmark
QUIET PAVEMENT RESEARCH

Key Findings:

• Extensive amount of research currently underway in Europe regarding noise.
• Research is a vital part of the European culture.
• Complex relationships with private entities to fund far reaching research objectives.
• Under the Road to the Future program, companies are encouraged to submit innovative ideas for research. Selection of an innovative idea is a highly sought after award and is often used as a marketing tool for other company services and products.
Key Findings (cont.):

- Roads to the Future work in the Netherlands should be reviewed for application in US.
- The noise absorption techniques observed in the Netherlands and Italy relative to the Helmholtz resonators and absorbing pavement layers should be monitored for long-term performance.
- Additional data from Belgium should be obtained relative to their long-term experience with exposed aggregate concrete.
- Additional research on optimized diamond grinding should be evaluated relative to noise reduction and pavement texturing.
- Low noise gap graded mixes used in Europe should be considered for use in the US.
Safe, durable, economical, and “quiet” pavements can be constructed.

- Standardize noise measurements practices in the US.
- Develop an integrated approach to noise mitigation.
- Educate.
- Develop American solutions to pavement noise.
- The time to implement is now!
SCAN TEAM IMPLEMENTATION PLAN (STIP)

(as of 02/2005)

• FHWA-sponsored workshop to develop roadmap to quieter highways; Sept 2004.
• Concrete Pavement Surface Characteristics Research Workshop; Nov 2004.
• FHWA Expert Task Group (ETG) – currently forming; oversee FHWA roadmap objectives.
• NCHRP projects: 1-44 Measuring Tire/Pavement Noise at the Source, 10-67 Texturing of Concrete Pavements.
• Noise intensity testing in Europe (NITE) – baseline of US and European pavements; Fall 2004.
• Concrete industry workshop; planned for Aug 2005.
• Asphalt industry workshop; planned for Nov 2005.