Asphalt - The Quiet Pavement

Controlling Highway Noise

• Sound
  ◦ mechanical energy transmitted by pressure waves (sound waves) (as in air) that is the stimulus to hearing

• Noise
  ◦ one that lacks agreeable musical quality or is noticeably unpleasant
Controlling Highway Noise

Urban Noise Sources

- Road Traffic: 60.0%
- Trams/Buses: 5.0%
- Others: 3.0%
- Railway: 5.1%
- Planes: 0.9%
- Enterprises: 11.9%
- Neighbors: 12.9%
- Recreational: 1.0%
- Unknown: 0.3%

Controlling Highway Noise

FHWA Guideline = 67 dB(A)

- Pain Threshold: 180 dB
- Hearing Hazard: 80 dB
- Hearing Threshold: 0 dB

- Space shuttle (@ 100') = 20,000 Pa
- Rock concert = 20 Pa
- Jet plane (@ 1000') = 2 Pa
- Truck (@ 30') = 0.2 Pa
- Normal conversation = 0.02 Pa
- Whispering = 0.002 Pa
- Quiet bedroom = 0.0002 Pa
Doubling Traffic adds 3dBA

65 Decibels

68 Decibels
Controlling Highway Noise

Side-Line Measurements
- Microphones at 5 & 50m
- Measures all Sources
- Requires Flat, Open Terrain

Controlling Highway Noise

FHWA - Noise Abatement Criteria

• Projects that Require Evaluation
  • Increase Capacity
  • New Alignments

• Maximum level = 67 dB(A)
• Maximum Change = 10 dB(A) change

“this is not an absolute value or design standard, only a level where noise mitigation must be considered”
On-Board Sound Intensity Measurements

Control Options
- Distance
- Obstructions
- Source
Control Options

• **Distance**
  ◦ Lengthen Path/Relocate Receiver

• **Obstructions**
  ◦ Insulation at Receiver
  ◦ Obstacles in Path

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**Berms & Walls**

• Require a large amounts ROW
• Massive amounts of earthwork
• May not be an Option in Urban Areas
• No Overall Reduction from Source
Noise Walls
Effective only for those not in the line-of-sight.

Does nothing reduce noise at source.

Controlling Highway Noise

Not as Effective For second And Third Tier Homes

0 dB(A) Reduction

Noise Walls Shadow Effect

5-10 dB(A) Reduction
Controlling Highway Noise at the Source

Control Options

• At the Source
  ◦ Vehicles
    • Smaller, Lighter
    • Quieter Less Aggressive Tread Patterns
  ◦ Traffic
    • Lower Speeds
    • Traffic Calming (avoid Starting & Stopping)
  ◦ Pavement Surfaces
Positive Texture

Negative Texture

Chip Seal

Positive Texture

Source: Transtec
Positive Texture

Exposed Aggregate Concrete

Source: Transtec

Negative Texture

Tined Concrete

Source: Transtec
Controlling Highway Noise at the Source

Arizona 101 Wayside Data at 50 ft - Pre & Post Project OGFC
Uncorrected for Traffic Volume/Speed/Mix

Before and After Comparison Site 3A

Negative Texture

Smooth Rolled Asphalt

Source: Ulf Sandberg

1/3 Octave Band Center Frequency, Hz
Sound Pressure Level, dB

PCC Avg (82.2 dBA)
OGFC Avg (74.3 dBA)
Controlling Highway Noise at the Source

European Experience

• Dense Population
• Limited ROW
• Historical Vistas
• Need to Reduce Overall Noise Level

European Pavements @ 97 km/h

Sound Intensity Level, dBA

- PA
- PCC
- DGA
- DLPA
- SMA
Controlling Highway Noise at the Source

France
Two-layer Open Graded Friction Course
• Expedite Drainage
• Prevent Clogging

• Aggregate Lift / Thickness
  • Bottom 11-14/40-50 mm
  • Top 6-8/25-30 mm

• Environmental Award for Quiet Pavement

Data Base - California & Arizona

[Bar chart showing sound intensity levels for OG/RAC, PCC, and DGA pavements]
Sound Propagation Tests

- Measure average sound intensity over face of the loudspeaker.
- Subtract sound pressure level from average sound intensity level to calculate difference.
- Measure sound pressure at 25 & 50 ft.

Controlling Highway Noise at the Source
Noise is Important to the Public.

Current Mitigation Techniques
- Expensive
- No Overall Reduction

Controlling Noise at the Source
- Improves Smoothness
- Improves Skid-Resistance
- Reduces Overall Emissions
- Uses Existing Technology
Controlling Noise at the Source

- Routine Overlay Program
- No need to wait
- Done as Maintenance
- SMA & OGFC Mixes
- Designed for Hi-Stress Locations

Thank You!

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