Deployment and Evaluation of Sinusoidal Rumble Strips

8 March 2017

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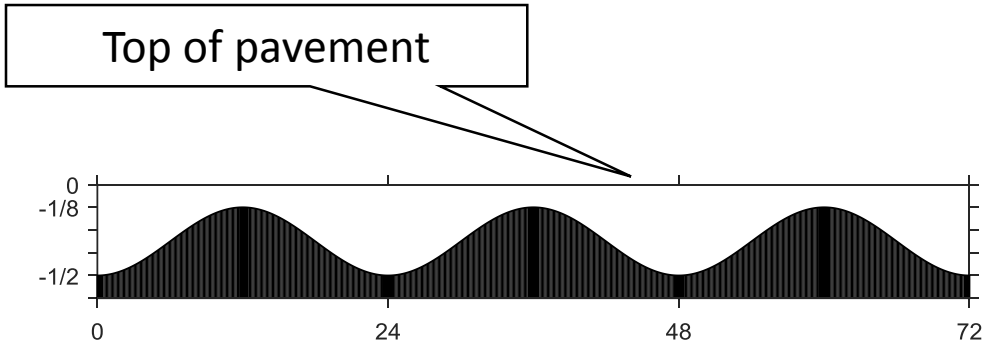
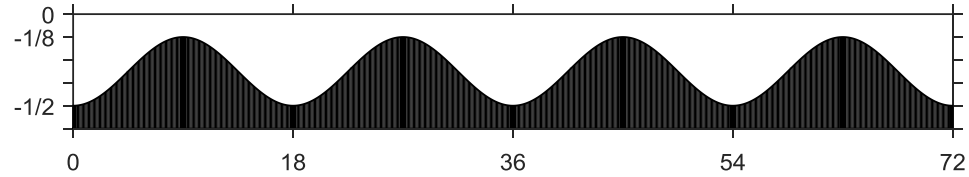
Standard INDOT Rumble Strips

Side View (not to scale)

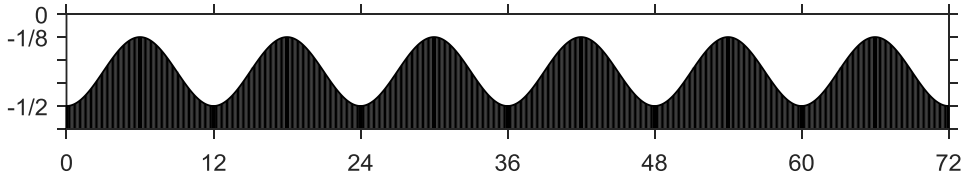
Sinusoidal Rumble Strips



a) 24” wavelength



b) 18” wavelength



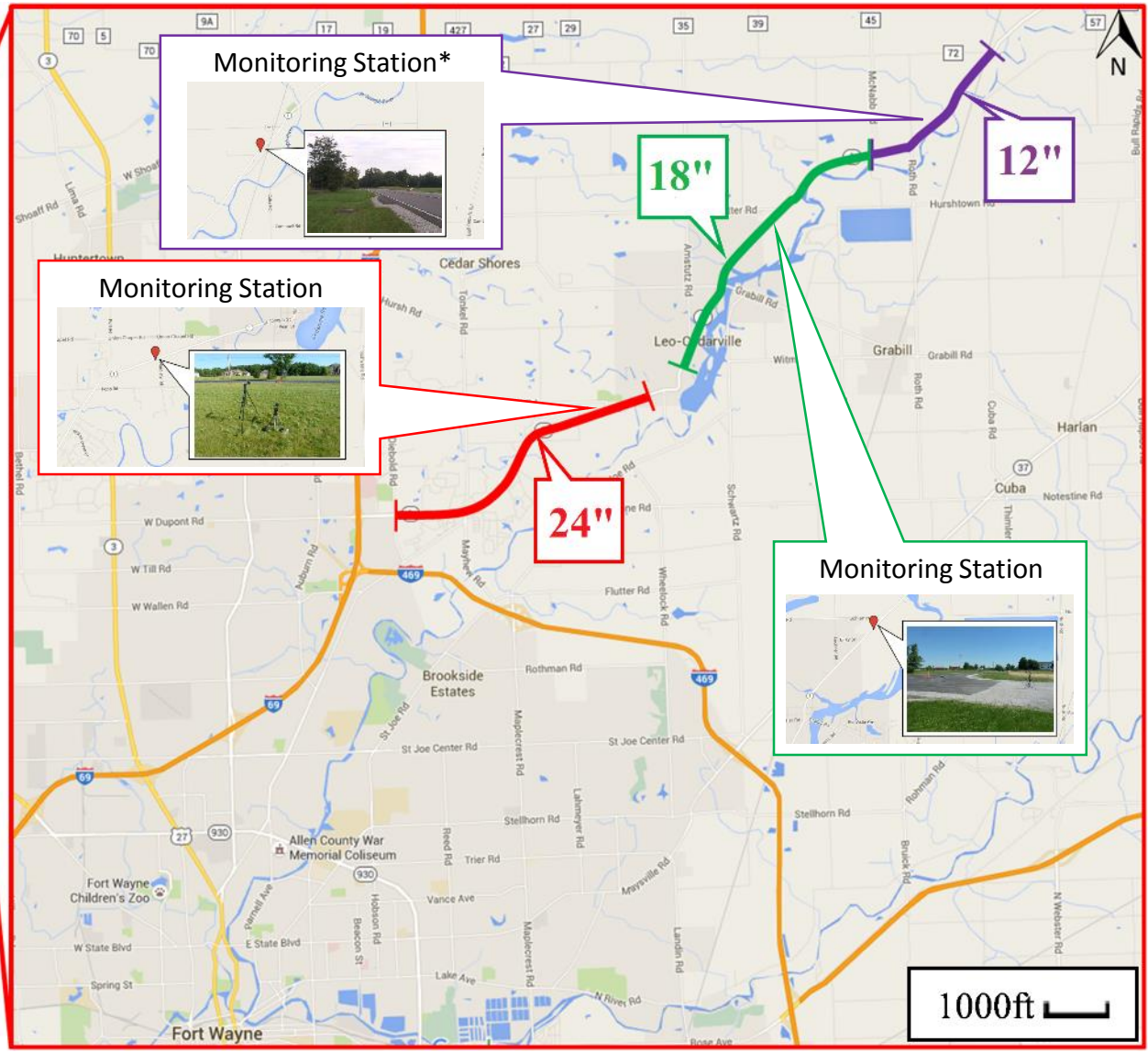
c) 12” wavelength

Problem Statement

Construct an experimental test bed to determine if 12”, 18”, and/or 24” wavelength sinusoidal rumble strips can reduce the noise impact on adjacent homes while still providing warnings similar to current technology.

Location

IN 1, Fort Wayne, IN



* Monitoring Location where test video (in a later slide) was shot

Ft. Wayne Initial Visit on 1 June 2016

Sinusoidal Rumble Strips Construction

08 June 2016

Fort Wayne, IN

Construction Video

https://youtu.be/pzj6uzymL-U

Construction of Sinusoidal Rumble Strips

IN 1, Fort Wayne, IN

08 June 2016

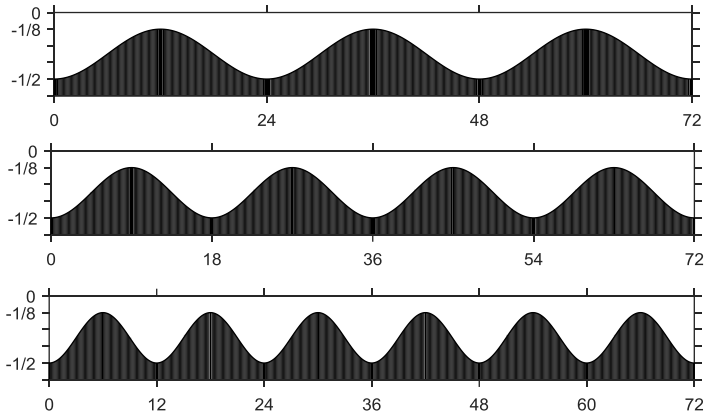
JOINT TRANSPORTATION RESEARCH PROGRAM
Discovery with Delivery
Since 1917
JTRP

INDIANA DEPARTMENT OF TRANSPORTATION
INDOT

PURDUE UNIVERSITY

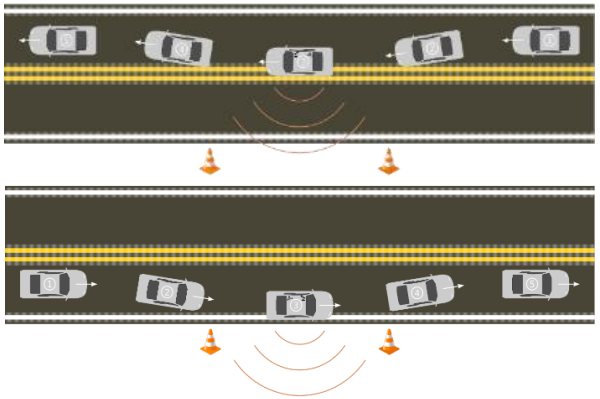
Test Scenarios

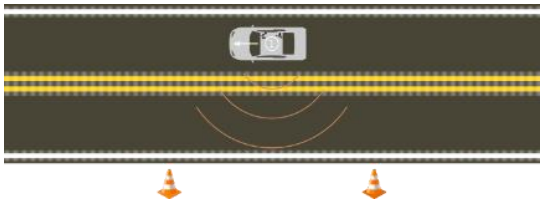
- 6 Vehicles
- 3 Wavelengths
- 3 Configurations
- Speeds



Center line

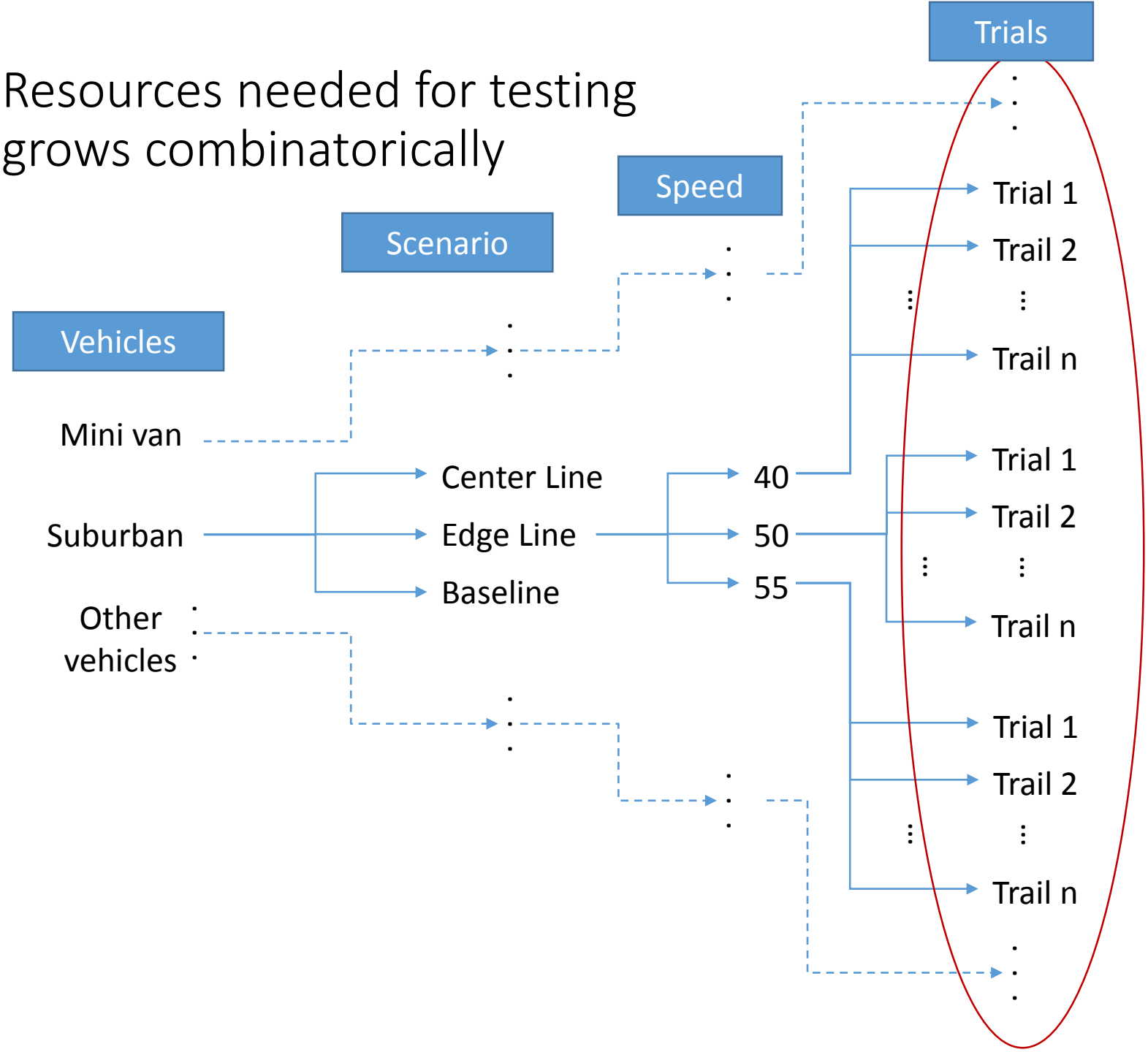
Edge line





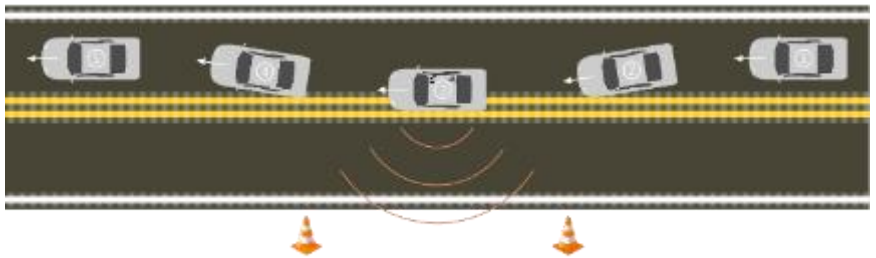
Baseline

Resources needed for testing grows combinatorically

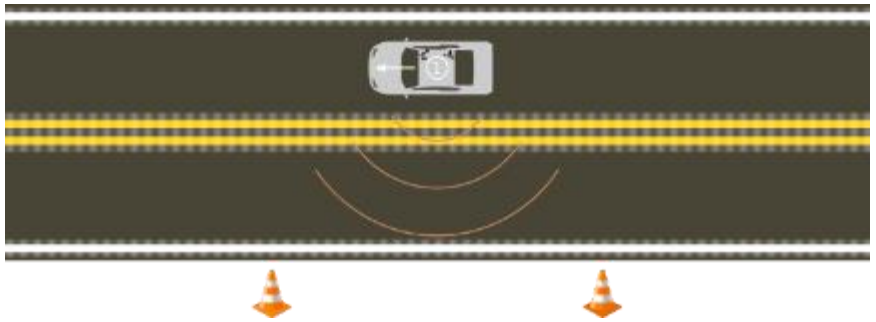


Final Test Scenarios

Speed = 50 mph and Number of trials =3



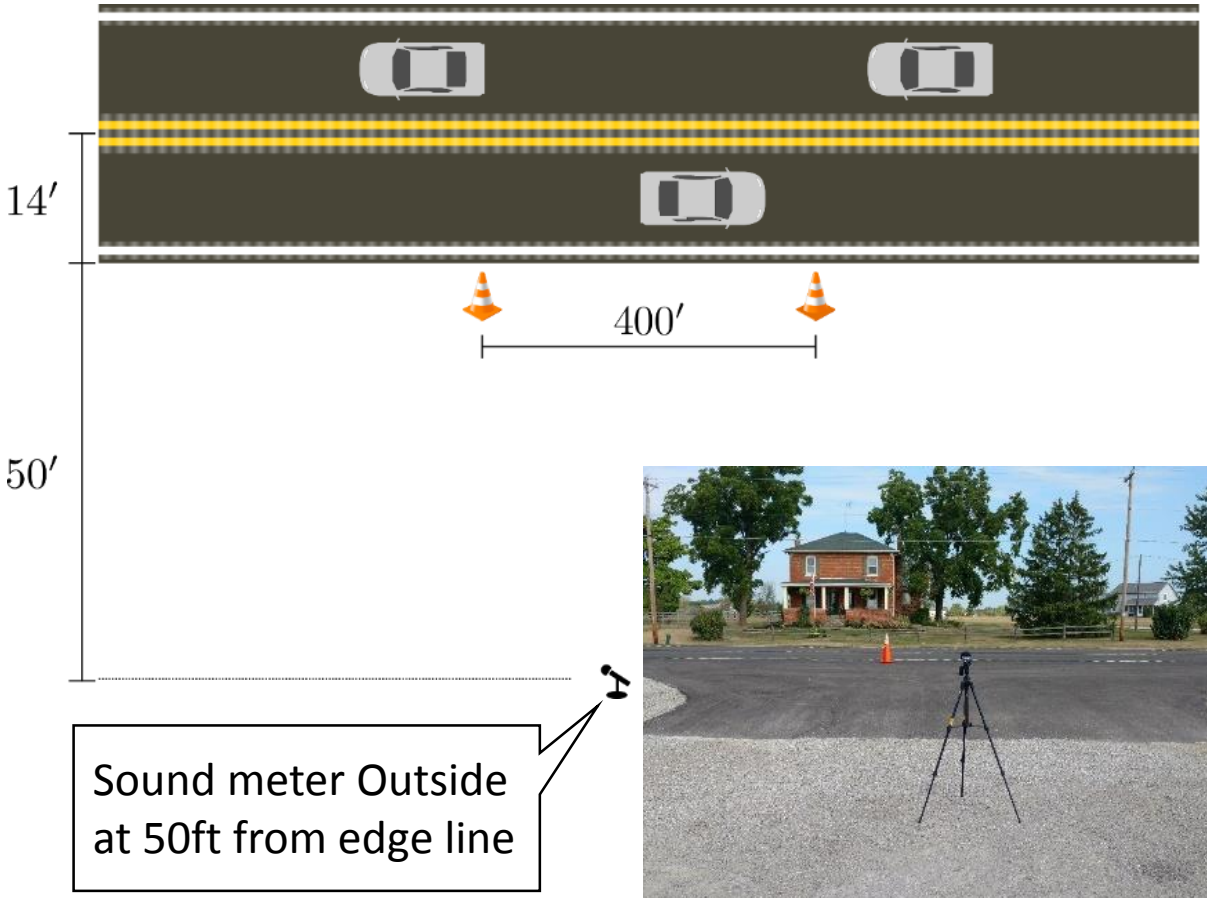
Center Line

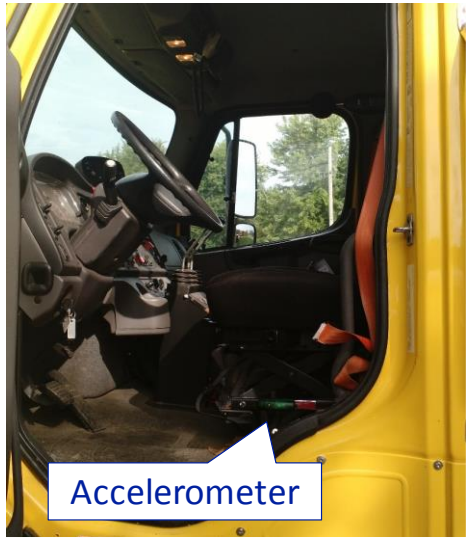


Baseline (No rumble) Far

Test Setup


Sound meter
inside


14′
400′
50′
Sound meter Outside
at 50ft from edge line


Accelerometer

Test Day

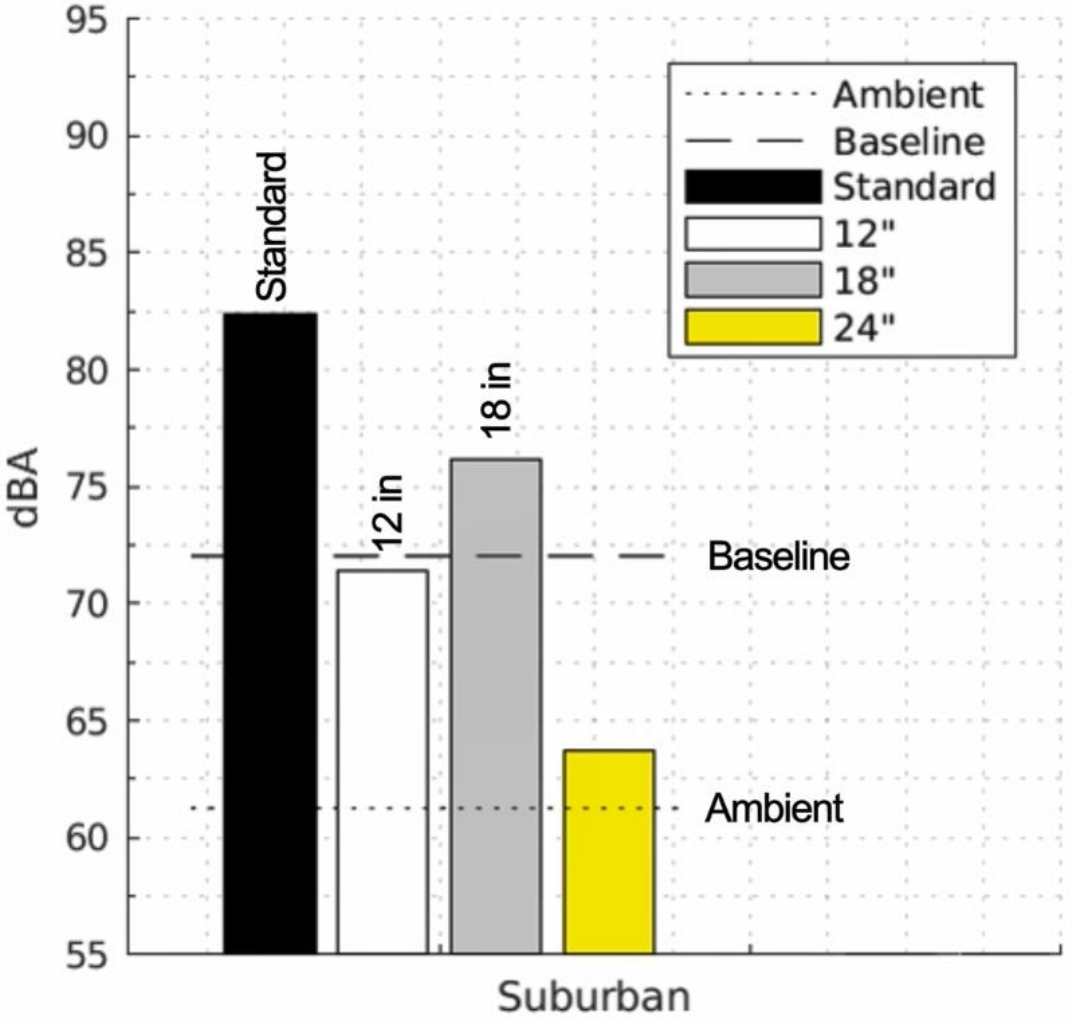
21 September 2016

Fort Wayne, IN

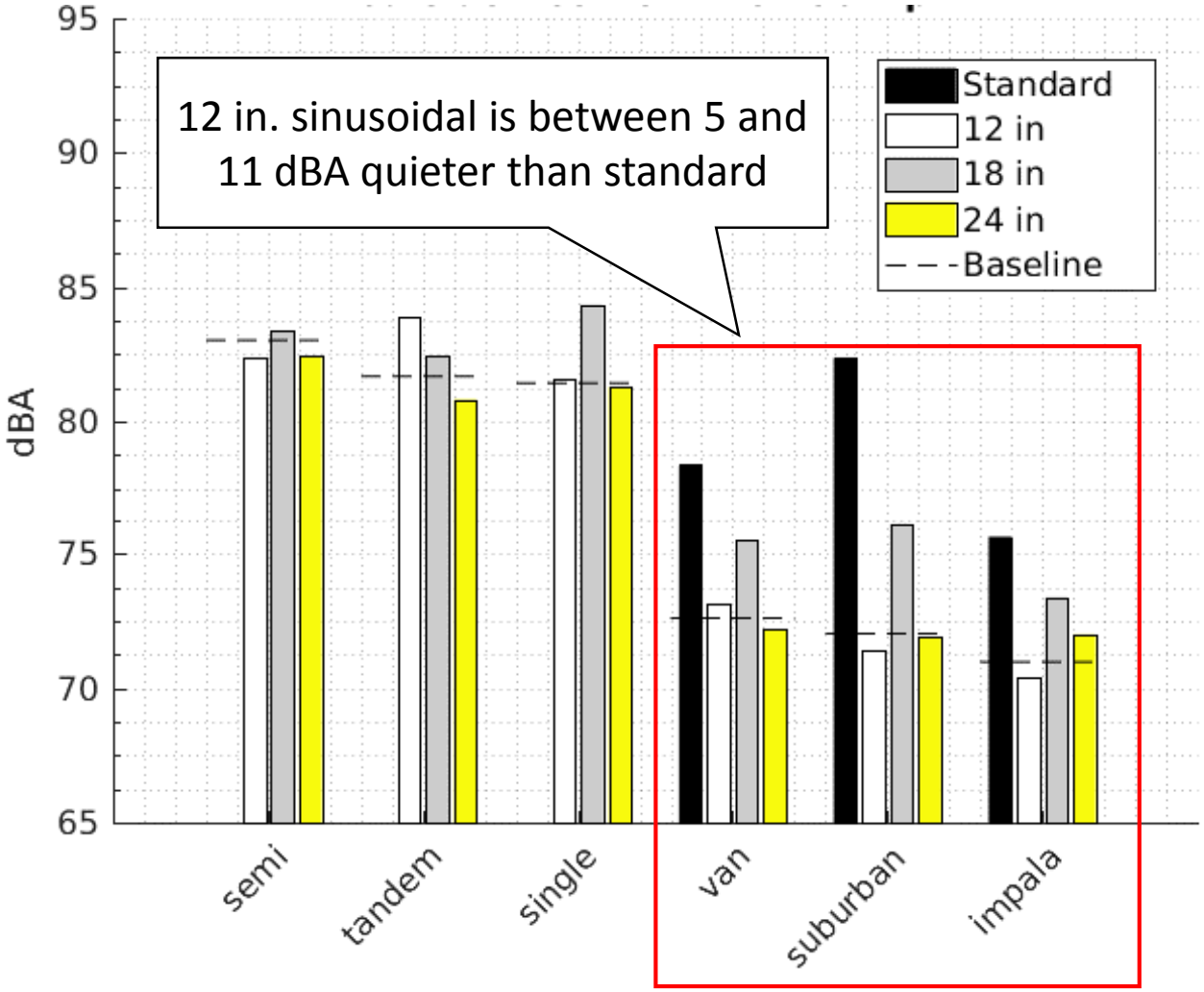
TEST VEHICLES

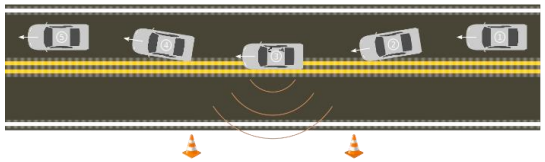
Video of Noise Level Data Collection

https://youtu.be/ABYNl_7u1-8



Center Line
Sound Meter: Outside
Speed: 50mph



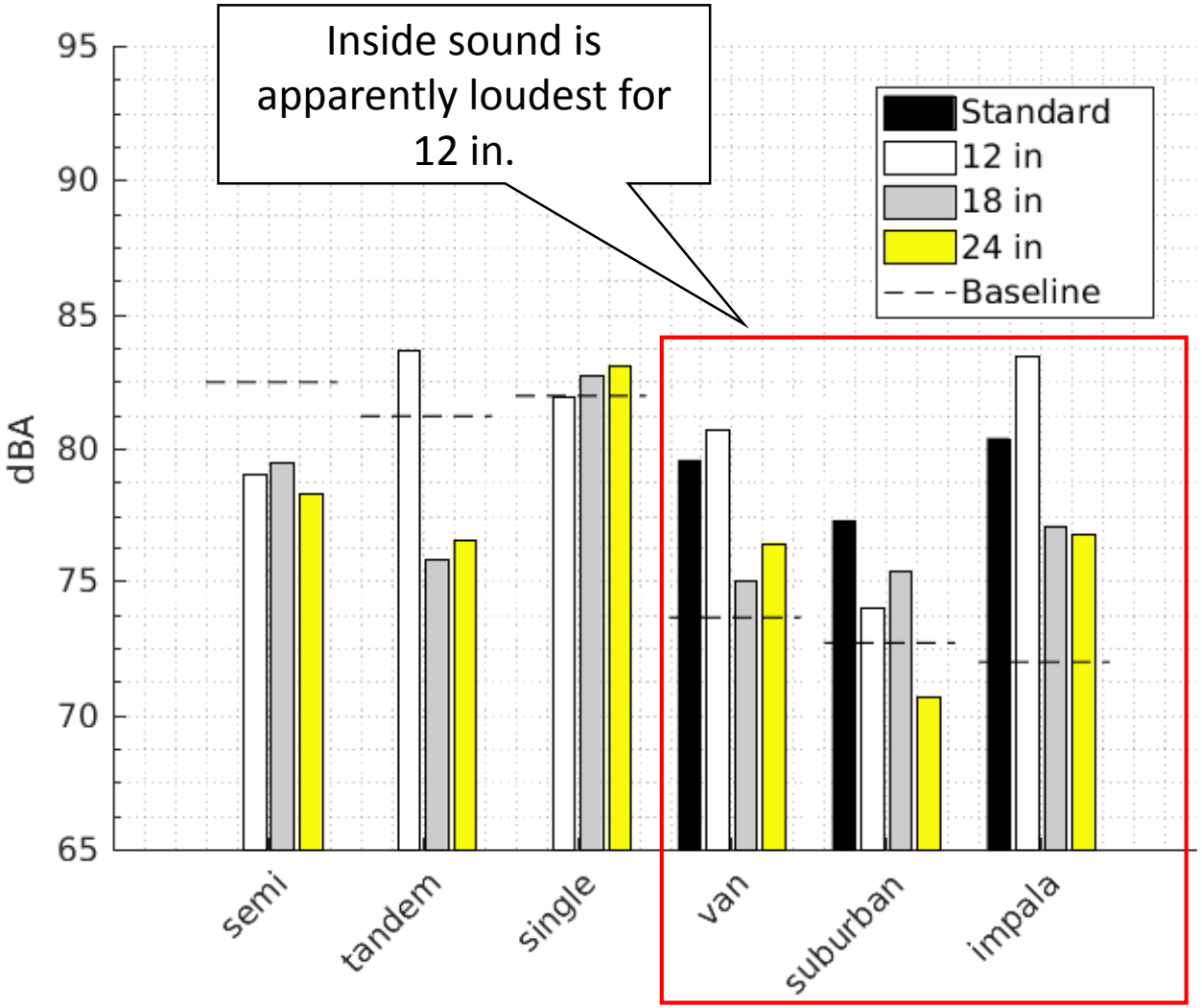


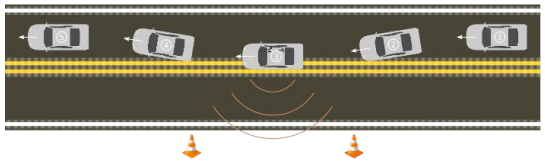
Center Line Incursion

Sound meter outside

Video of suburban on all the rumble strips
https://youtu.be/vakEKaWDcOo

Center Line
Sound Meter: Inside
Speed: 50mph





Center Line Incursion

Acceleration Traces

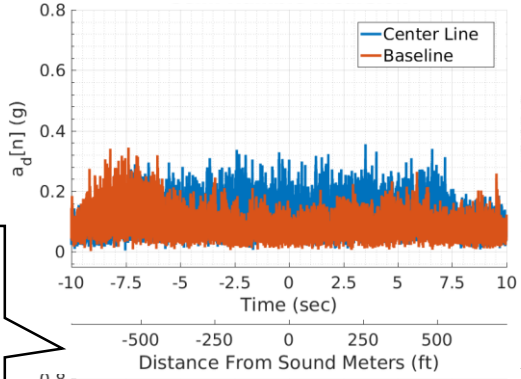
Semi

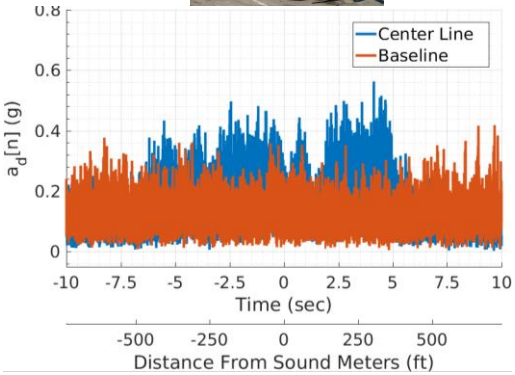
Tandem Axle

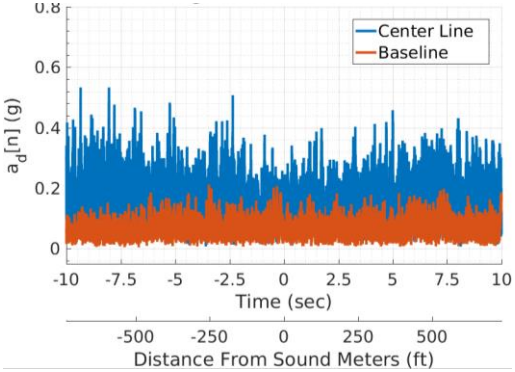
Single Axle

12in

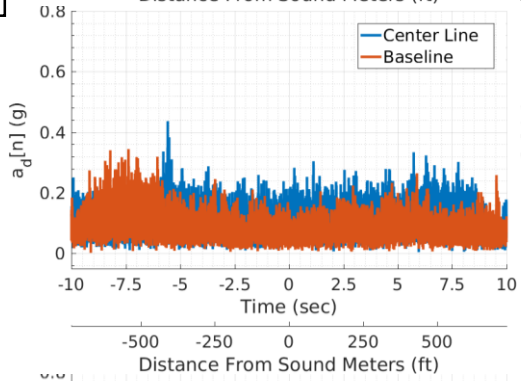
Can barely detect rumble vibrations

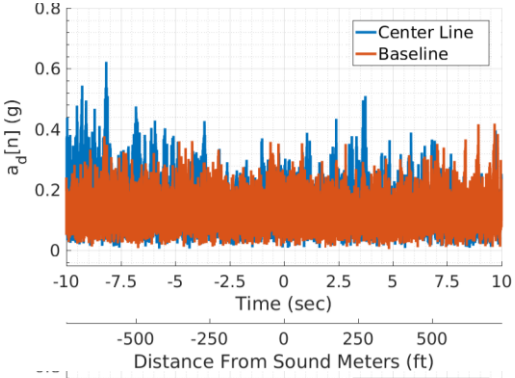


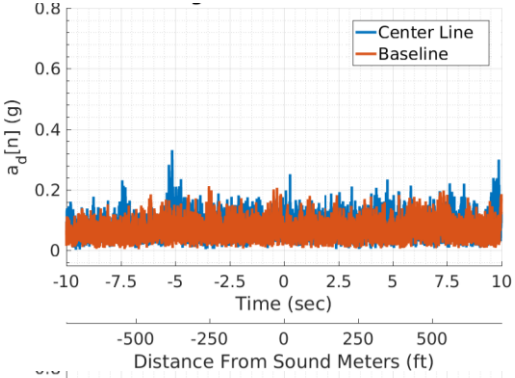




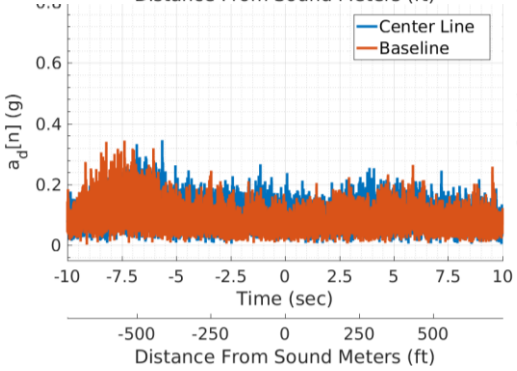
18in

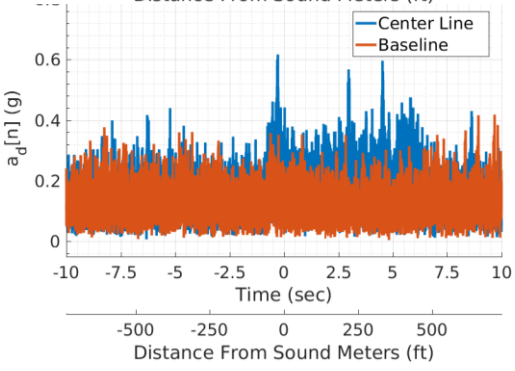


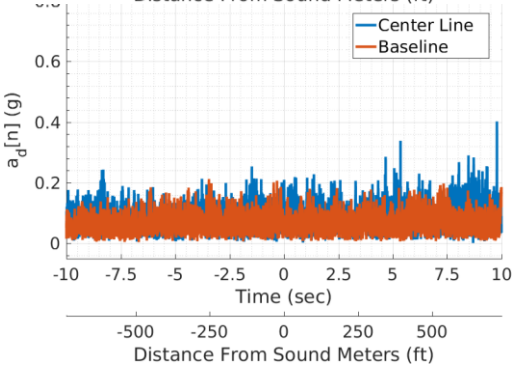




24in







Acceleration Traces

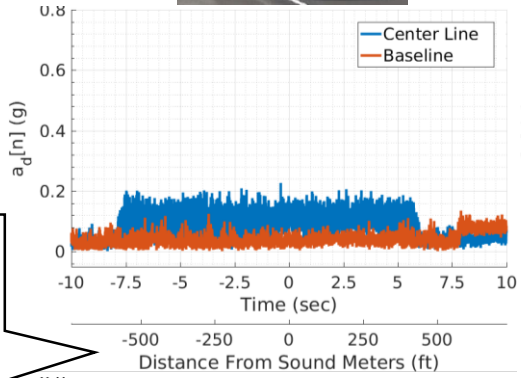
Suburban

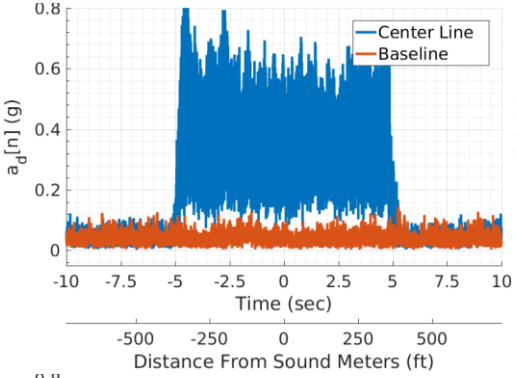
Minivan

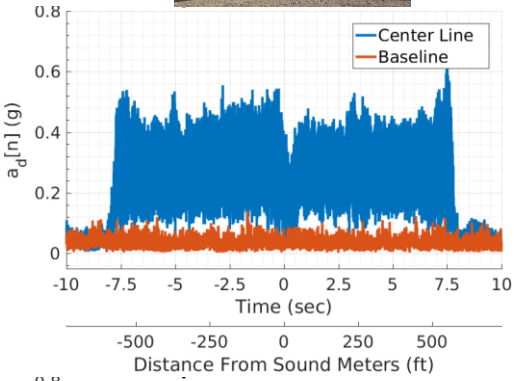
Impala

12in

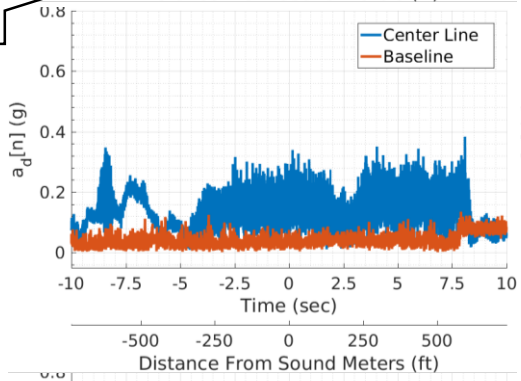
Clearly distinguish center line rumble strips from base line pass by

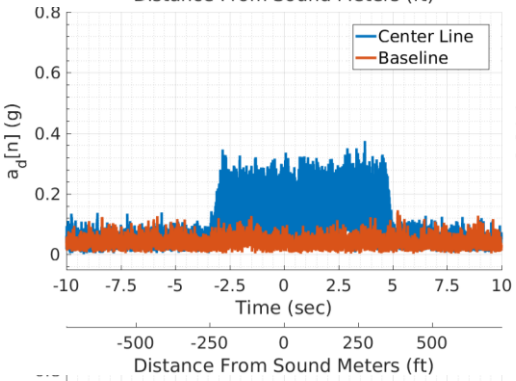


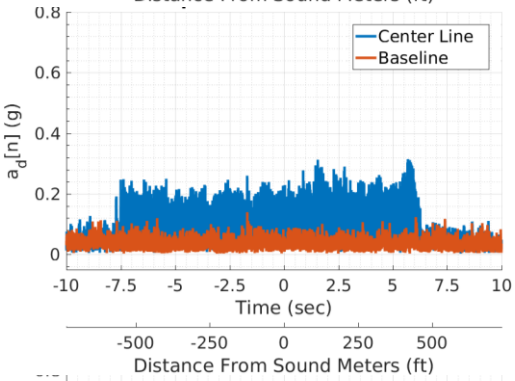




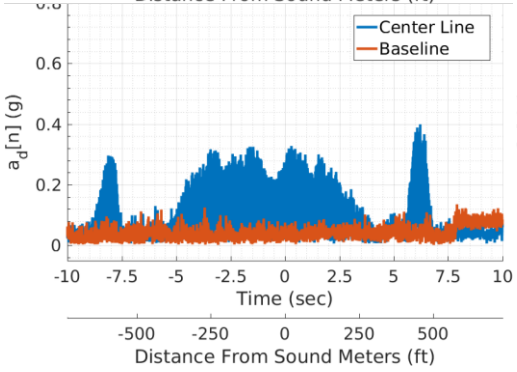
18in

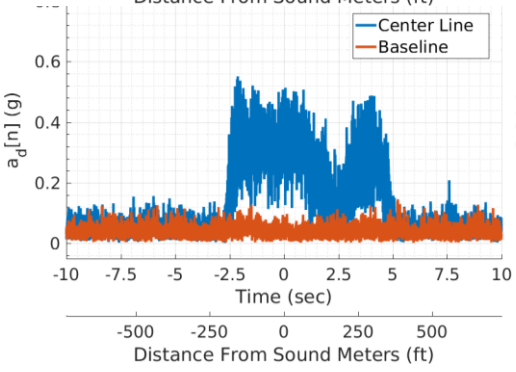


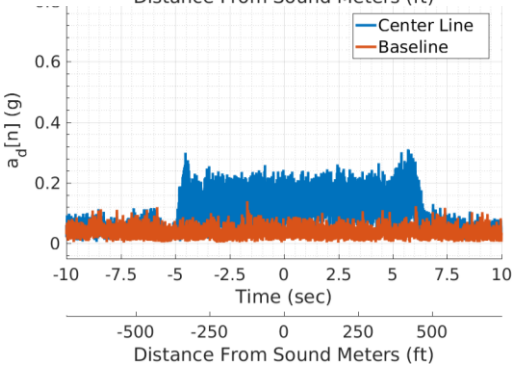




24in







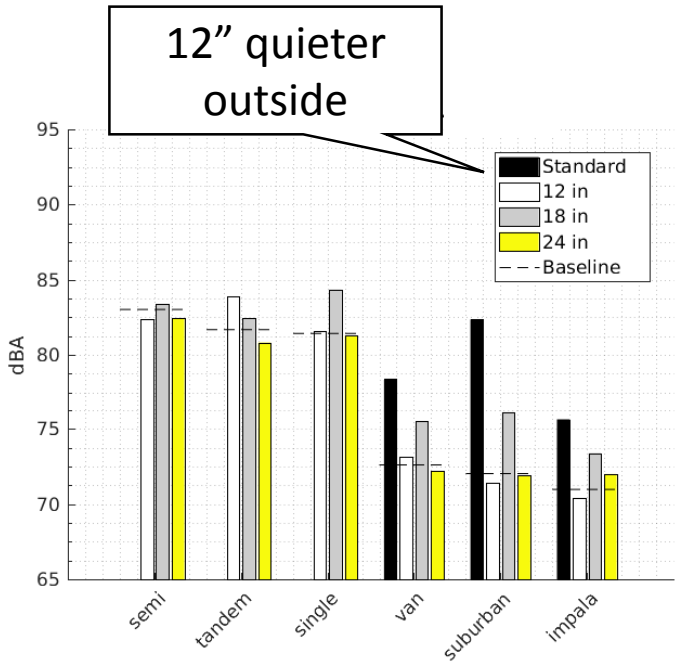
Comparison of Ft. Wayne Tests with NCHRP Guidelines

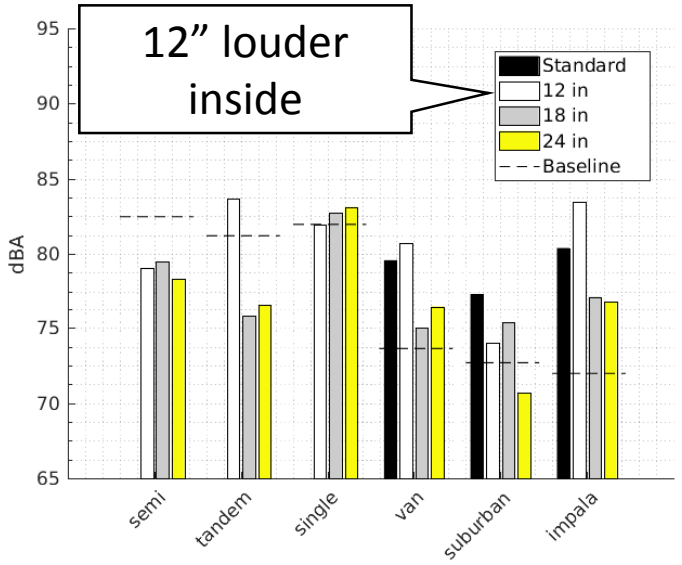
	Outside	Inside
NCHRP* Recommendations	To limit exterior noise near residential land uses, sound should not increase by more than 12 dBA and preferably by less than 6 dBA	In-cabin (inside) sound level should increase by 10 dBA and preferably over 15 dBA.
12”	 0 to 1 dBA above baseline	 4 to 12 dBA above baseline
18”	 3 to 5 dBA above baseline	 1 to 5 dBA above baseline
24”	 0 to 1 dBA above baseline	 0 to 4 dBA above baseline
Standard	 5 to 11 dBA above baseline	 5 to 8 dBA above baseline

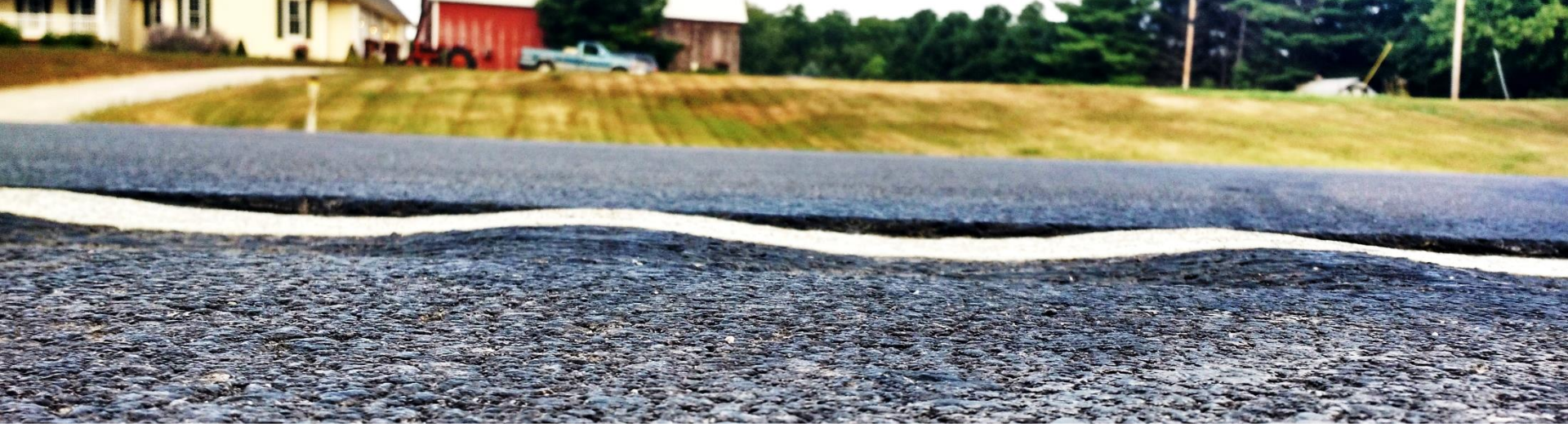
* NCHRP Report 641 on Guidance for Design and Application of Rumble Strips

Recommendation

- The sound levels are vehicle dependent
- From outside, 12” was found to be quieter than the standard INDOT rumbles (5 to 11 dBA)
- From inside, 12” was found to produce a sound level increase of 4 to 12 dBA compared to base line road noise
- Among the 3 sinusoidal wavelengths, 12” was the only one that routinely satisfied the NCHRP recommendations for in-cabin and exterior sound levels







Questions?