

The Convergence of Road Profiling and Automotive Design



How will the paths cross?

Road Profiler User Group Conference
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Vehicle Durability and
Performance Testing

California
Proving Grounds

HATCI

- Admin / HR / ACC.
- Design Engineering
- Laboratory Testing
- Powertrain
- Electronics Dev.
- Planning / Regulations

Chino Laboratory

California Emissions Testing
Fuel Cell Fleet

Irvine Technical Center
& Design Studio

Kia Design Studio

HMMA

- Support Engineering
Improvements
- Quality improvement

KMMG

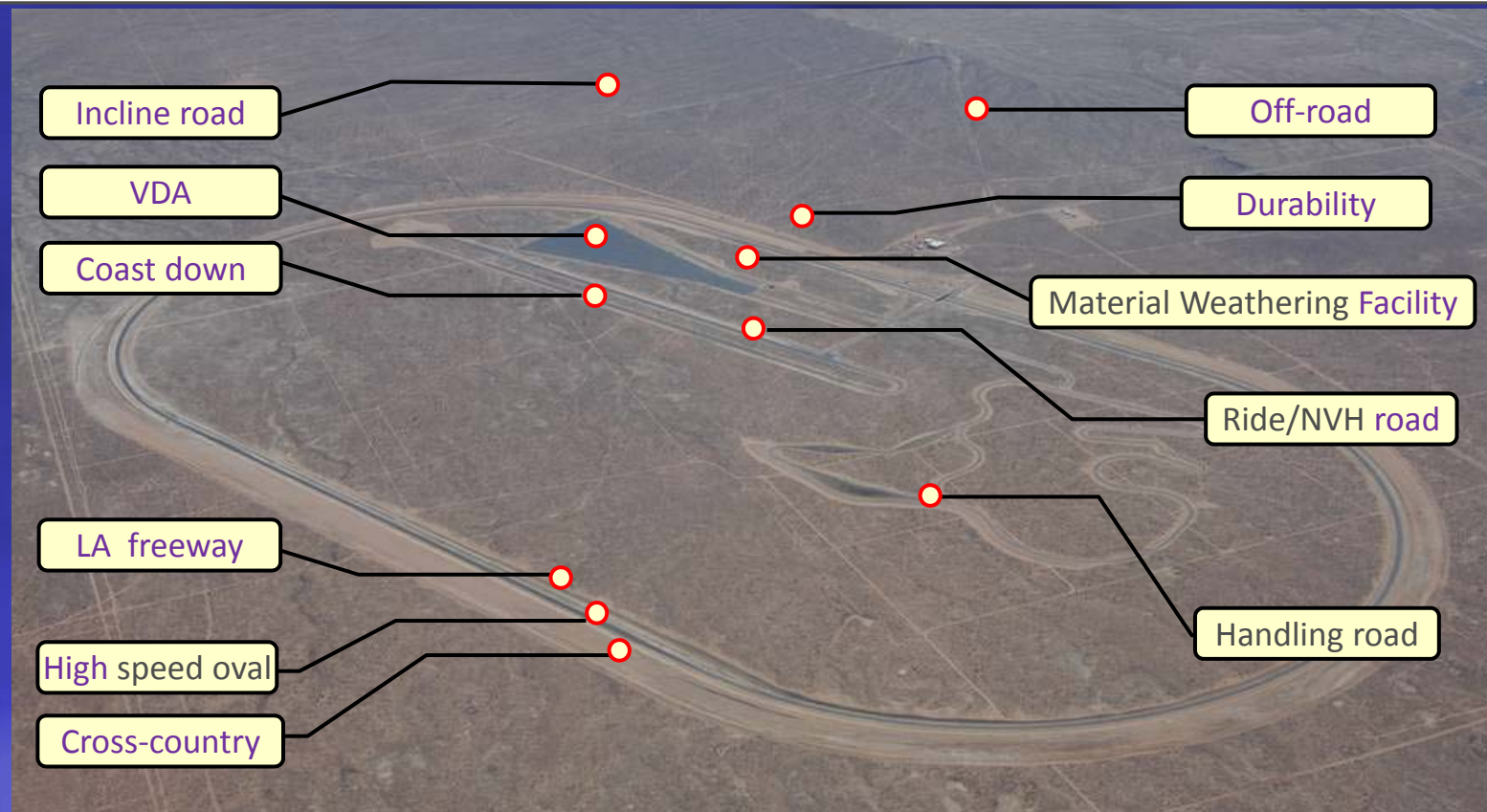
- Design products for North American Market
- Separate facilities to differentiate brands

HATCI Road Test Capability



California Proving Grounds (CPG)

- Site : 4,368 acres, approximately 11 square miles , over 40 miles of road and test tracks
- Construction Started: 2003 Opened : 2005
- Primary functions: Vehicle development, safety confirmation, quality & durability testing



Other Places We Test Vehicle Performance

Vehicle Performance Development based on various environment
: Suspension /Braking/ NVH / Audio system / HVAC

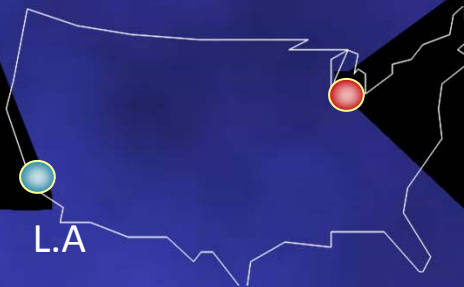
Heater, A/C development



Audio system test



NVH test
Brake performance test



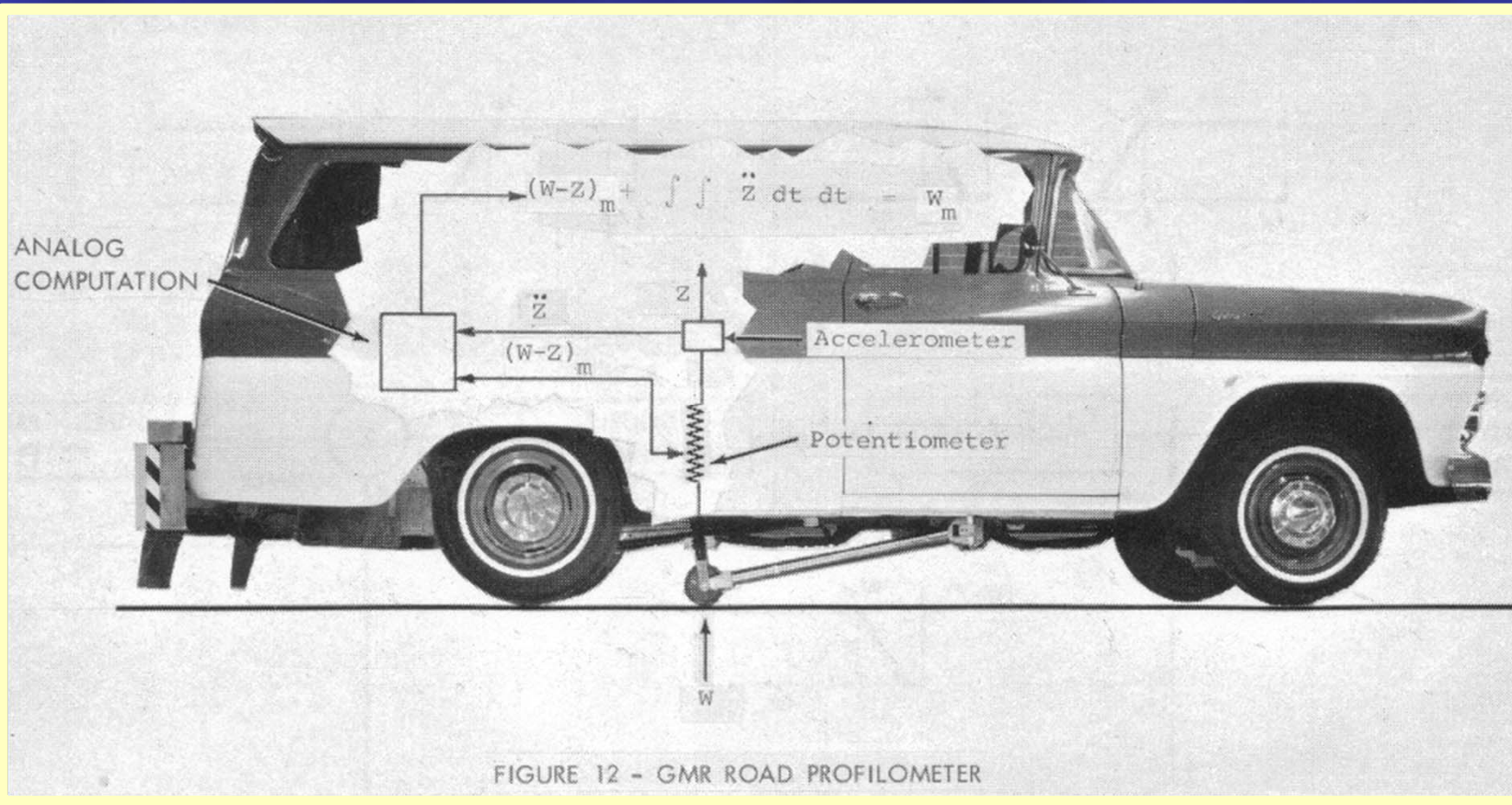
Suspension Tuning & Tire test

	① Summer	② Winter	③ High Altitude
			
	Death Valley, Indio desert	Minnesota	Mt. Evans
Test Items	Drivability HVAC	Engine, Braking, Heating & Driveability	Engine Startability, Climbing Performance, Braking

A Little History of Road Profiling

1964:

- Elson Spangler and Bill Kelly of General Motors invent the first internal profiler.



More History

Soon After:

- State DOT's begin using profilers based on the Spangler/Elson design.
- Michigan DOT and Texas DOT are among first to utilize the design.
- FHWA begins pushing more usage.



More History

Eventually:

- Dave Huft builds the “South Dakota Profiler”
- South Dakota hosts the first RPUG meeting in 1986.



... and the world is never the same again

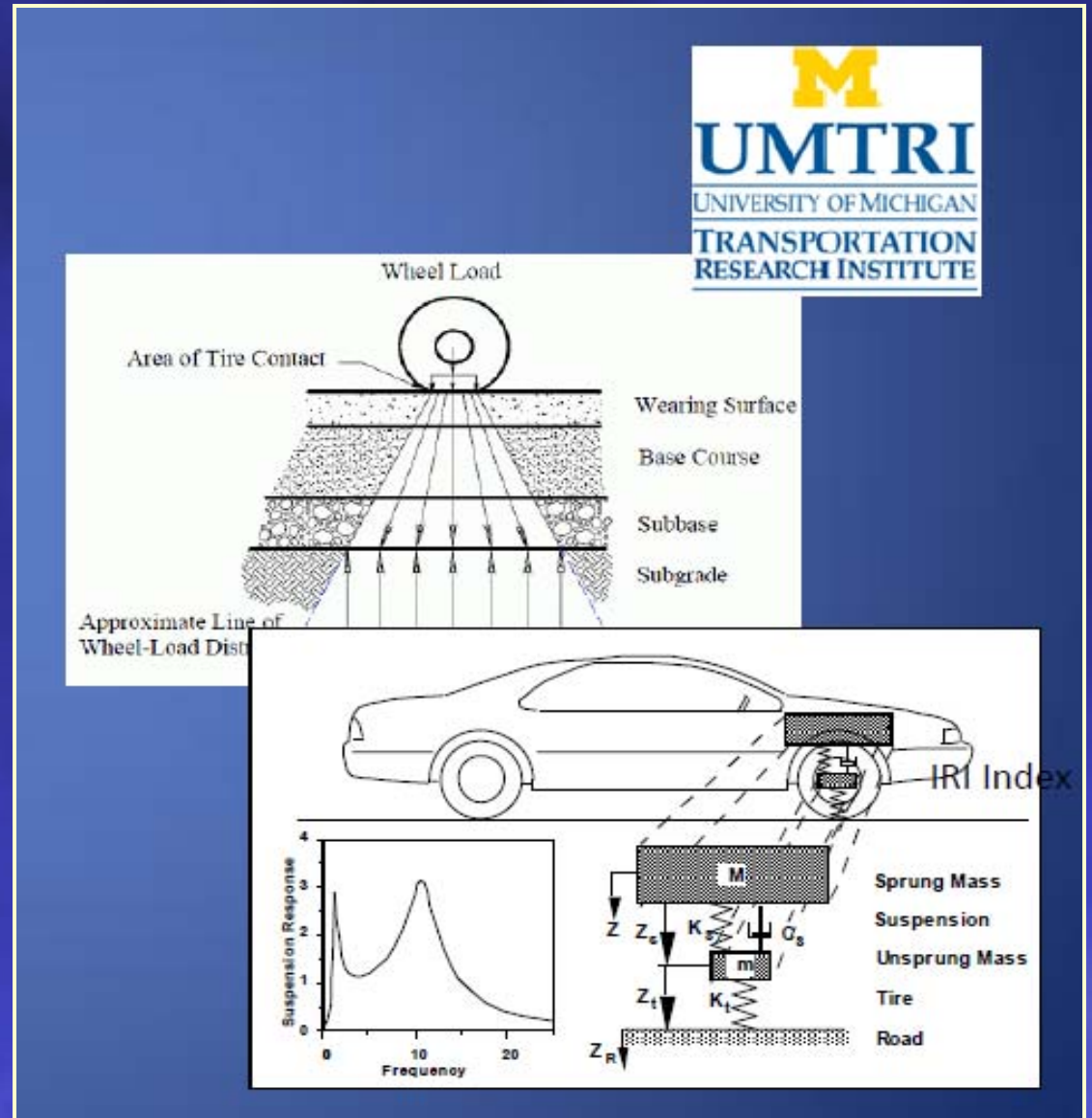


Improvements.....

International Roughness Index (IRI)

Definition:

A statistic used to estimate the amount of roughness in a measured longitudinal profile



Where We Are Today



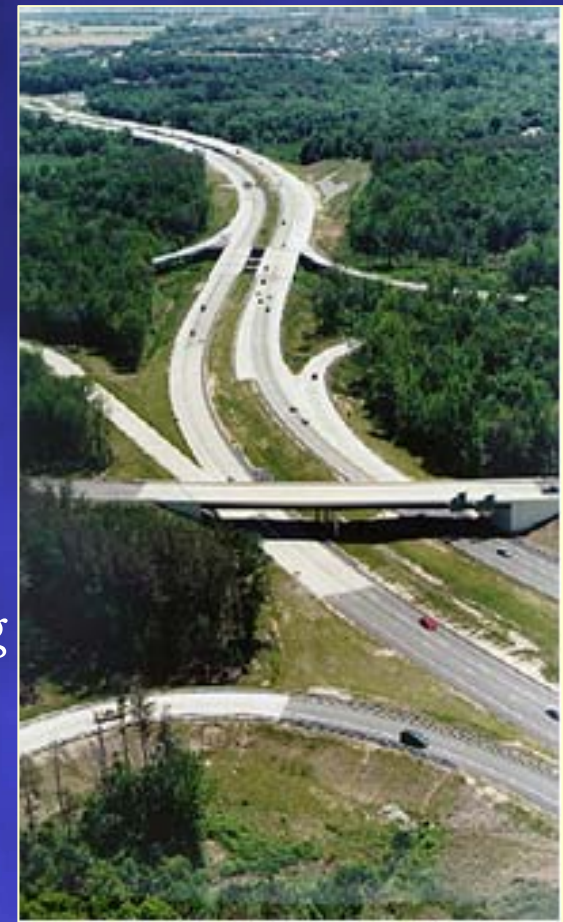
U.S. Department of Transportation
Federal Highway Administration

Now:

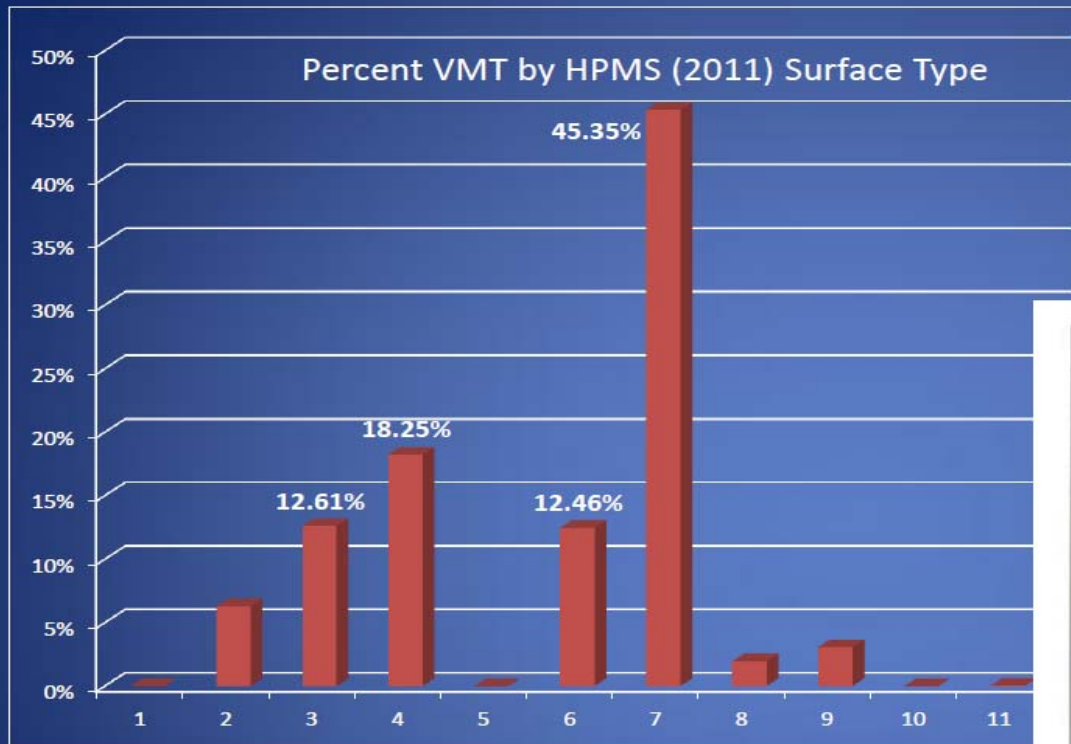
- FHWA produces the Highway Performance Monitoring System (HPMS)
- Hyundai-Kia America Technical Center, Inc. (HATCI) has contracted with the UMTRI to determine the “average road surface” in the United States using HPMS.



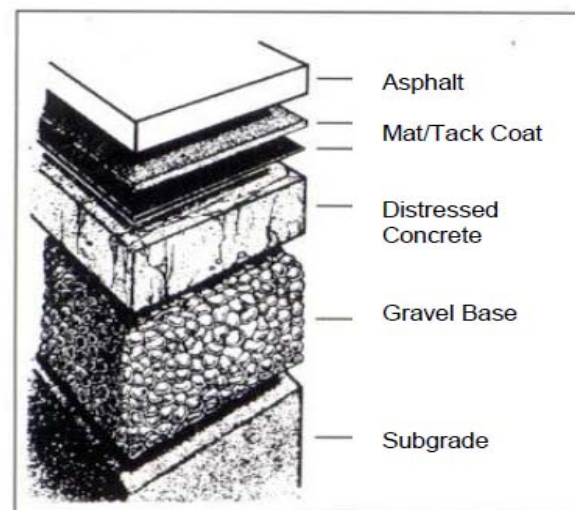
HYUNDAI-KIA
AMERICA TECHNICAL CENTER, INC.



Initial Findings (Region V)



88.67% of Miles Driven are over 4 of 11 Surface Types



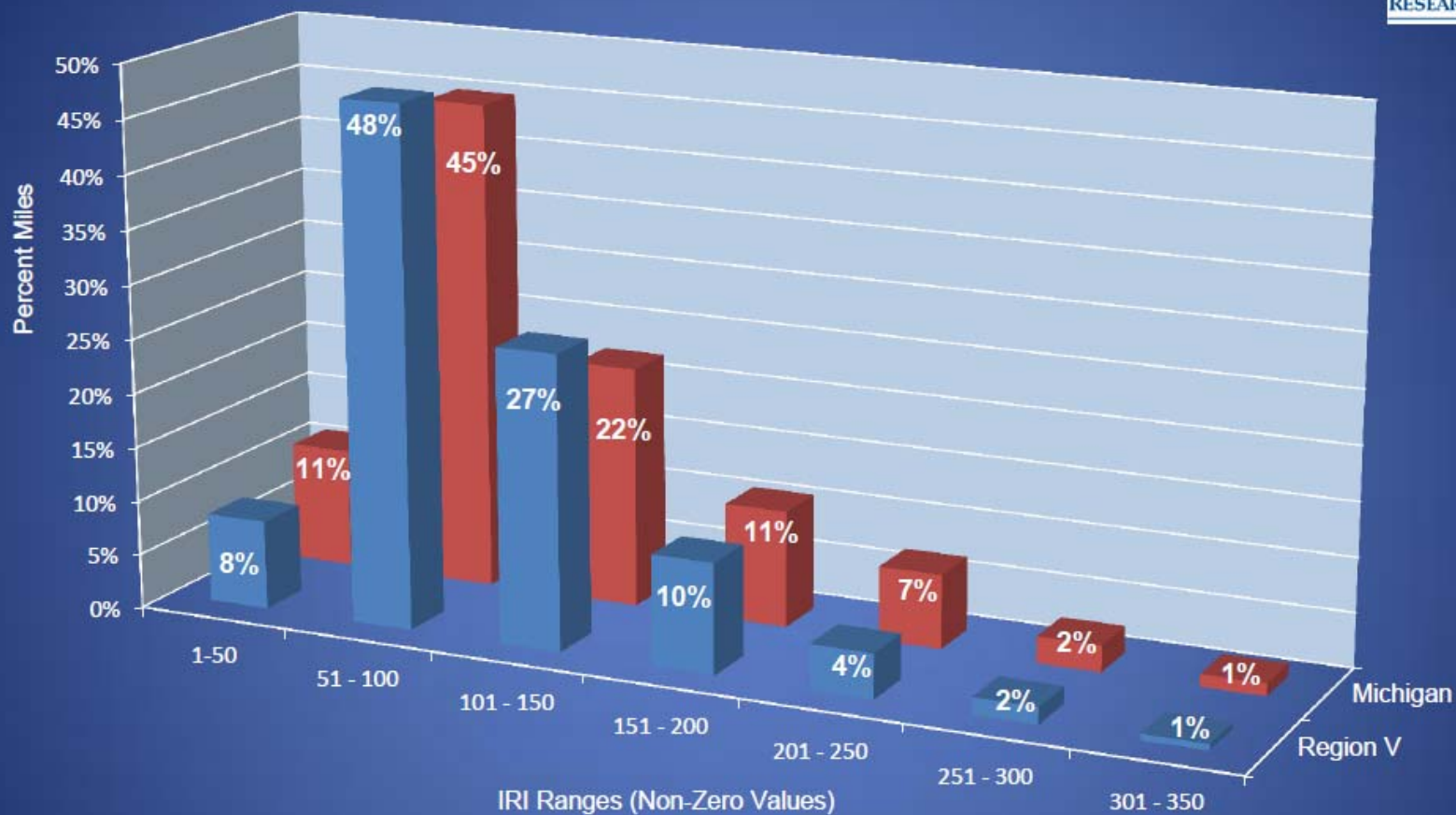
3 JPCP – Jointed Plain Concrete Pavement
4 JRCP – Jointed Reinforced Concrete Pavement
6 Asphalt-Concrete (AC) Overlay over Existing AC Pavement
7 AC Overlay over Existing Jointed Concrete Pavement



Initial Findings (Region V vs. Michigan)



Percent Vehicle Miles Traveled vs. IRI Ranges
Region V and Michigan HPMS 2011 Roads



How Is This Important To The Auto Industry?

Knowing more about road surfaces can dramatically assist vehicle designers

- NVH (Noise, Vibration, Handling)
- Knowing the frequency of operation on road “types” can influence design
- New technologies will depend on road design and infrastructure

The auto and road industries are converging

Major Current Challenges

Road surfaces affect many auto issues

- Ride, handling, and vehicle safety effects are well known
 - Rain and snow performance
 - Vibration
 - Braking
 - General noise effects

But other effects are critical as well

Major Current Challenges

- Road surface has a dramatic effect on fuel economy.
 - Surface composition, structure, wear, expansion joints, tining, etc.
- Voice recognition is a major new technological development
 - Roadway noise interferes with voice recognition
 - Audio operations are degraded

Major Future Challenges

- Lane departure warning relies on roadway marking and/or embedded infrastructure
- Vehicle to Vehicle communication (V2V)
 - Will allow vehicle monitoring for intersection crash avoidance and traffic control, but needs infrastructure
- On-road charging for electric vehicles
 - Will require embedded infrastructure

What Can We Do?

ENHANCING CONVERGENCE

The more we work together now,
the quicker that new technologies
can be introduced to improve the
driving experience, vehicle safety,
and the efficiency of the
transportation system as a whole

Credits

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