



Intelligent Compaction Technology



An Innovation in Compaction
Control and Testing

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Intelligent Compaction, IC



What is “Intelligence?”

- Oxford Dictionary: “...*able to vary behavior in response to varying situations and requirements*”
- Ability to:
 - Collect information
 - Analyze information
 - Make an appropriate decision
 - Execute the decision



FHWA IC Team



- 12 State Pooled Fund Partners...
- Roller & Test Equipment Manufacturers
- Lee Gallivan, HIPT
- Michael Arasteh, RC
- Fred Faridazar, R&DT
- Tom Harman, RC
- John D'Angelo, HIPT
- Bob Horan, SaLUT (*Support Staff*)

We've come a long way!



A black and white photograph showing a vintage car, possibly a Ford Model A, stuck in a deep, muddy rut on a dirt road. The car is facing the viewer, with its front wheels partially submerged in the mud. The license plate reads "2391". The background features a rural landscape with several houses, including a prominent two-story brick house in the center, and a wooden fence on the left. The sky is overcast, and the overall scene suggests a difficult driving condition.

Because we always ask...

How can we do it better?

What's the next innovation?

Roadway Compaction



- Proper in-place density is vital for good performance
- Conventional compaction procedures have some limitations...
- Intelligent compaction technology appears to offer “*a better way*”



Conventional Limitations



- Density Acceptance...



Limited Number of Locations

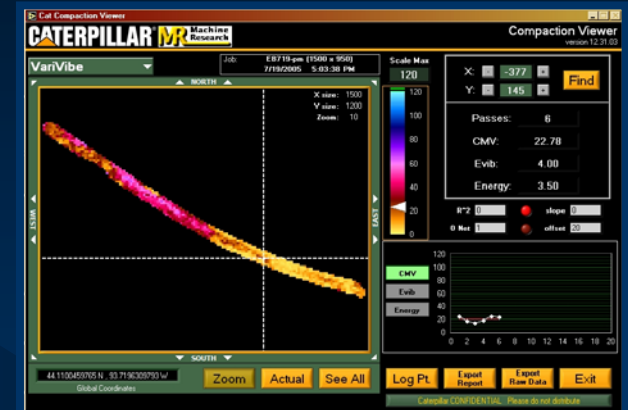


After Compaction is Complete

Intelligent Compaction



Can we make the process...smarter?



Improved Roller Technology

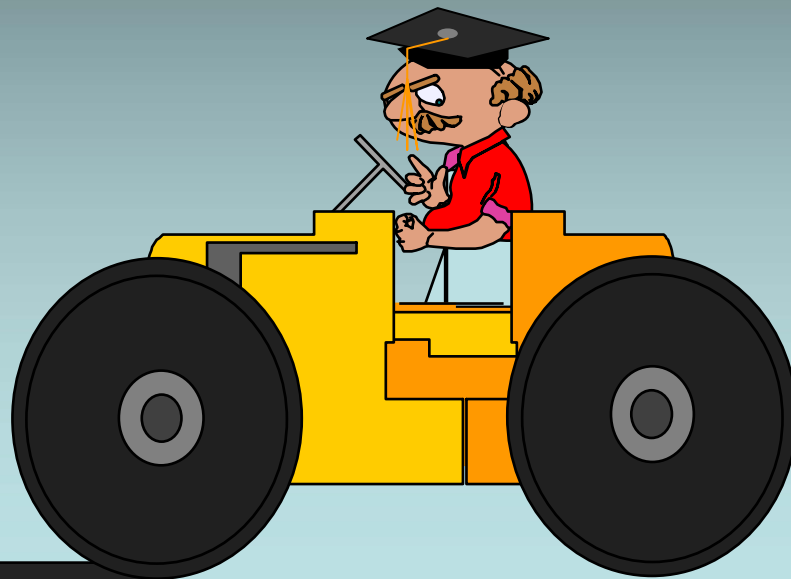
Sophisticated / Clear Documentation Systems



Advanced Hardware & Software



Intelligent Compaction, IC



IC TPF / FHWA Definition



1. Vibratory rollers with measurement / control system
 - Measurement system, ex. material stiffness
 - Control system automatically changes parameters (amplitude and possibly frequency) based on measurement...



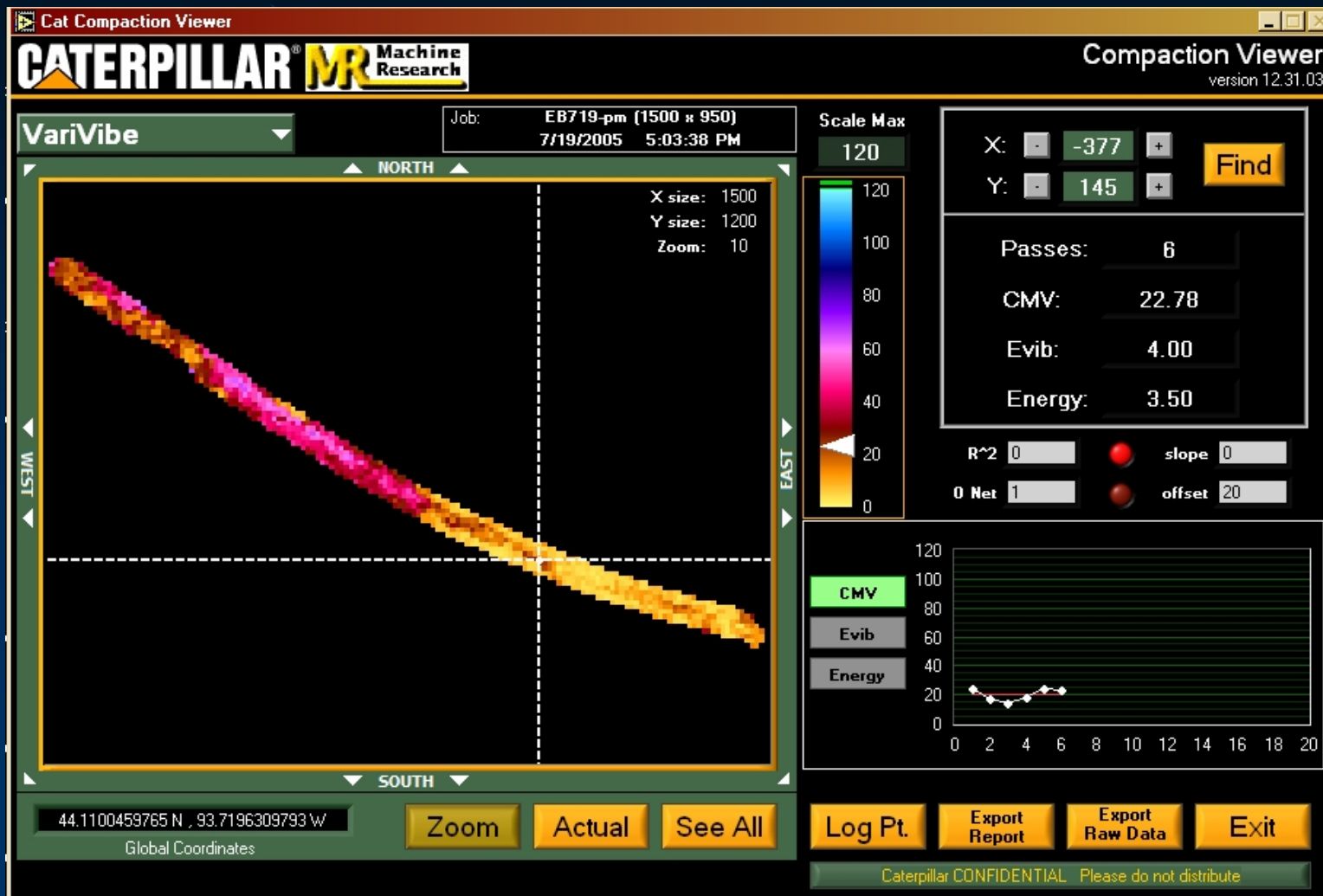
IC TPF / FHWA Definition



2. GPS-based documentation systems
 - Continuous recordation of materials stiffness
 - Continuous recordation of corresponding roller location
 - Color-coded mapping of stiffness



Ex. Caterpillar



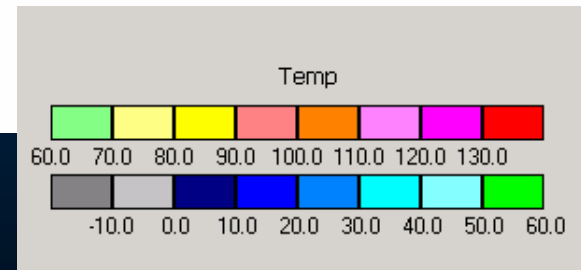
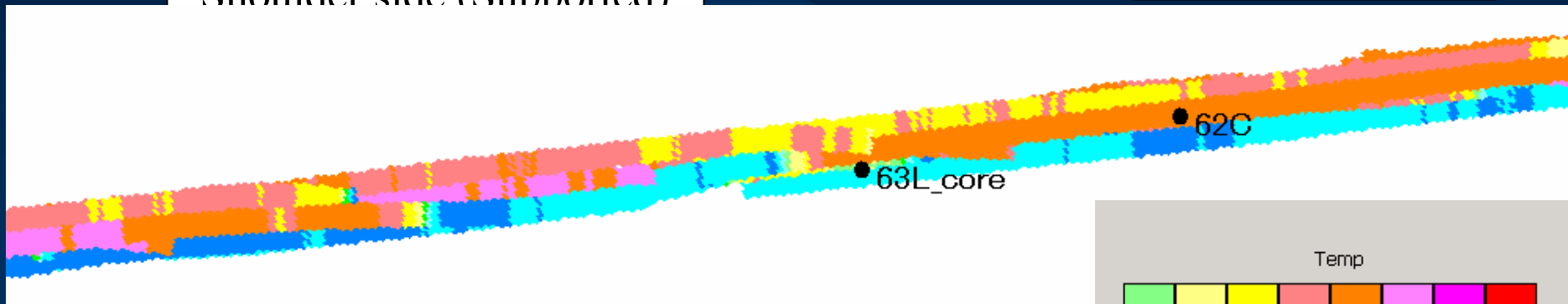
Sakai IC Roller Project



- Temperature

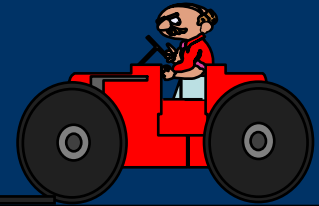
Shoulder side (Supported)

Paving Direction



Longitudinal Joint

Benefits of IC



- **Maximum productivity** of the compaction process
- **Improved density** of pavement materials
- **Measurement and recordation** of materials stiffness values
- **Identification** of non-compactable areas
- **Improved depth** of compaction
- **Reduction** in highway repair costs

National Research Efforts



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- NCHRP 21-09 “Examining the Benefits and Adoptability of Intelligent Soil Compaction”
 - Transportation Pooled Fund #954 – “Accelerated Implementation of Intelligent Compaction Technology for Embankment Subgrade Soils, Aggregate Base and Asphalt Pavement Material”

NCHRP 21-09 (Soils)



- Study of IC of subgrade soils (limited aggregate base/subbase)
- Objectives: Based on data / information obtained from field studies:
 - Develop generic IC construction specifications for subgrade soils
 - Evaluate the reliability of IC system components

NCHRP 21-09 Phase One Project



July 2006; MnROAD Research Center

NCHRP 21-09 Phase One Project

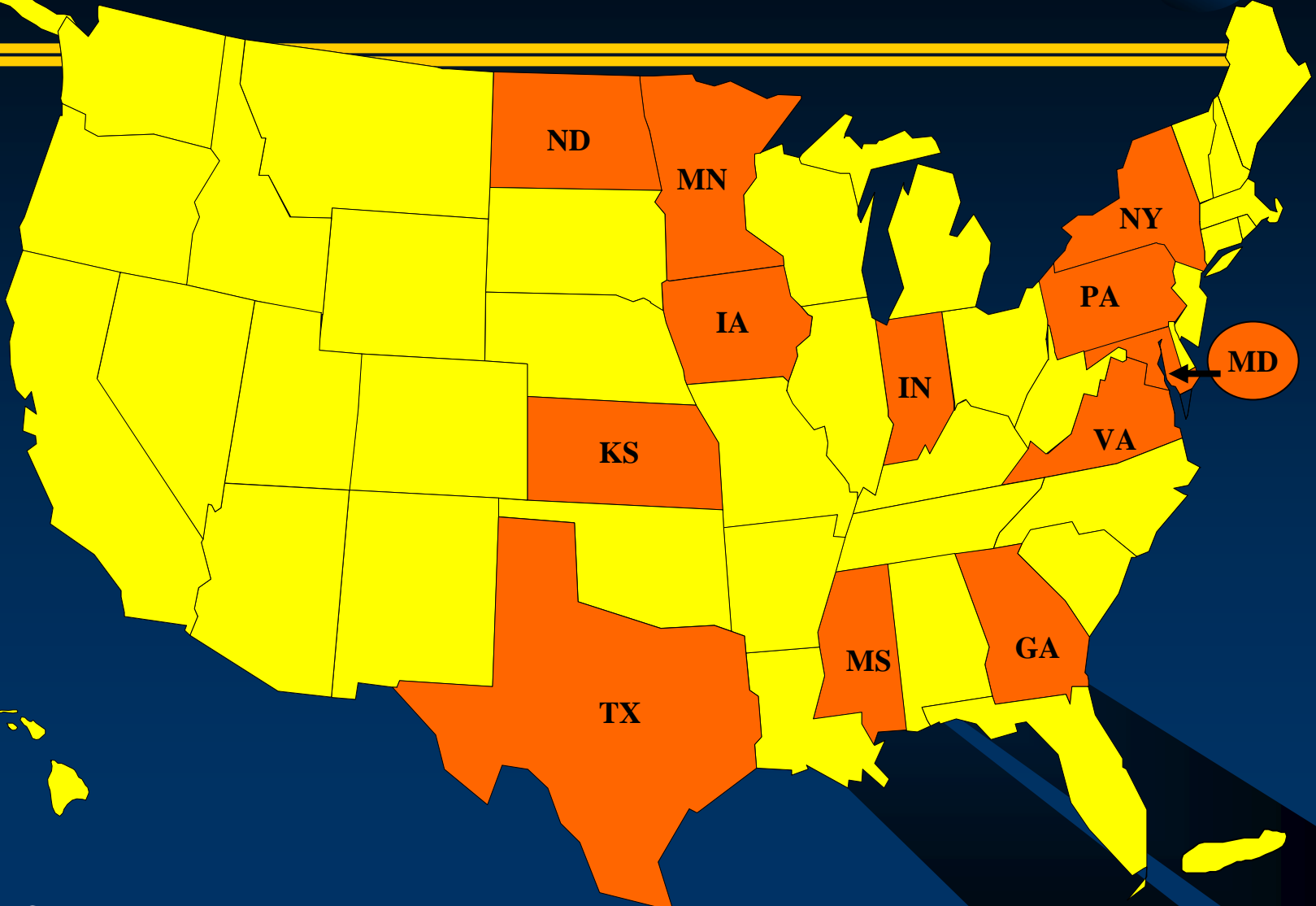


Pooled Fund (Soils / HMA)



- 3 year study of IC for all materials
- Solicitation period ended on Dec 2005
- 12 participating states
- Estimate 1+ project / State / year ~ 15-20?
- Close coordination with NCHRP project
- Stated goal to work closely with roller suppliers to increase the number of IC rollers and manufacturers

Accelerated Implementation of IC



Pooled Fund, Objectives



- Objectives: Based on data obtained from field studies:
 - Accelerated development of QC/QA specifications for granular and cohesive subgrade soils, aggregate base and asphalt pavement materials...

Pooled Fund, Objectives



- Develop an experienced and knowledgeable IC expertise base within Pool Fund participating state DOT personnel
- Identify and prioritize needed improvements to and/or research of IC equipment and field QC/QA testing equipment (DCP, FWD, GeoGauge, etc)

State DOT IC Research



- Limited number of projects by several State DOTs (MN, NC, MD)
- Mn/DOT has conducted an ongoing research effort over last several years
 - 5 projects complete
 - Subgrade soils only
 - 3 different roller manufacturers
 - Compare roller-generated output to in-situ test methods (DCP, LWD and GeoGauge)
 - Required GPS-based, color coded mapping of roller output and locations

IC Rollers

Current Status



- 5 Roller Manufacturers have announced their intentions to supply IC rollers in US
 - 4 have announced plans to have both single drum soils rollers and tandem drum asphalt rollers
 - 1 has only single drum soils rollers, at this time
- 4 Manufacturers that currently have IC rollers for public display, at this time:
 - Bomag America (both single and tandem drum)
 - Ammann America (single drum)
 - Caterpillar (single drum)
 - Sakai America (tandem drum)

Special Issues for HMA IC



- Thin lift construction
- Allowable temperature ranges
- Surface vs. internal temperature measurement
- Non-destructive, in-situ stiffness
- Response parameters

IC – Goals / Benefits



- **Short Term**

- Improve density... better performance
- Improve efficiency... cost savings
- Increase information... better QC/QA



A stylized landscape illustration. In the foreground, a grey road with a white dashed center line leads from the bottom center towards the horizon. The road is flanked by green hills. In the background, there are black silhouettes of mountains. The sky is a gradient from dark blue at the top to a bright yellow sun setting behind the mountains. The text 'Thank you!' is written in white in the upper right area of the sky.

Thank you!

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