



*Missouri Department of Transportation*

**2011 Transportation Research Forum**

***Intelligent Compaction (IC)***

***At MoDOT***

***March 10, 2011***

# MoDOT participation in SHRP2 project

- Project R07- Performance Specifications
- Developing Model specifications for Section 200 (Grading) of the MoDOT spec book
- Specifications are being drafted by consultant
- Pilot project selected to incorporate the performance specifications (Route 141, St. Louis County)



# Intelligent Compaction (IC)

- What is it?
  - Consist of machine-integrated sensors and controls systems on vibratory rollers
  - Provides a record of machine-ground interaction
  - Provides indication of ground stiffness/strength to some extent degree of compaction



# Intelligent Compaction (IC)

- What is it?
  - Global Positioning System (GPS) mapping is often included
  - Applicable to virtually all materials
  - Compaction monitors are mounted in or near drum to monitor compaction effort



# Intelligent Compaction (IC)

- What is it?
  - Calculates material response to compaction and shows variability
  - Soil response described in Compaction Meter Value (CMV)
  - Calibration procedure is needed to correlate CMV to stiffness or density



# Intelligent Compaction (IC)

- What is it?
  - Asphalt IC Rollers include additional temperature instrumentation
  - Used in Europe for more than 20 years
  - Provides indication of ground stiffness/strength to some extent degree of compaction



# Intelligent Compaction (IC)

- Expectations of IC
  - Improve construction efficiency
  - Streamline quality management programs
  - Provide more robust QA/QC
  - Improve performance of compacted materials-  
Reduction in Highway Repair Costs

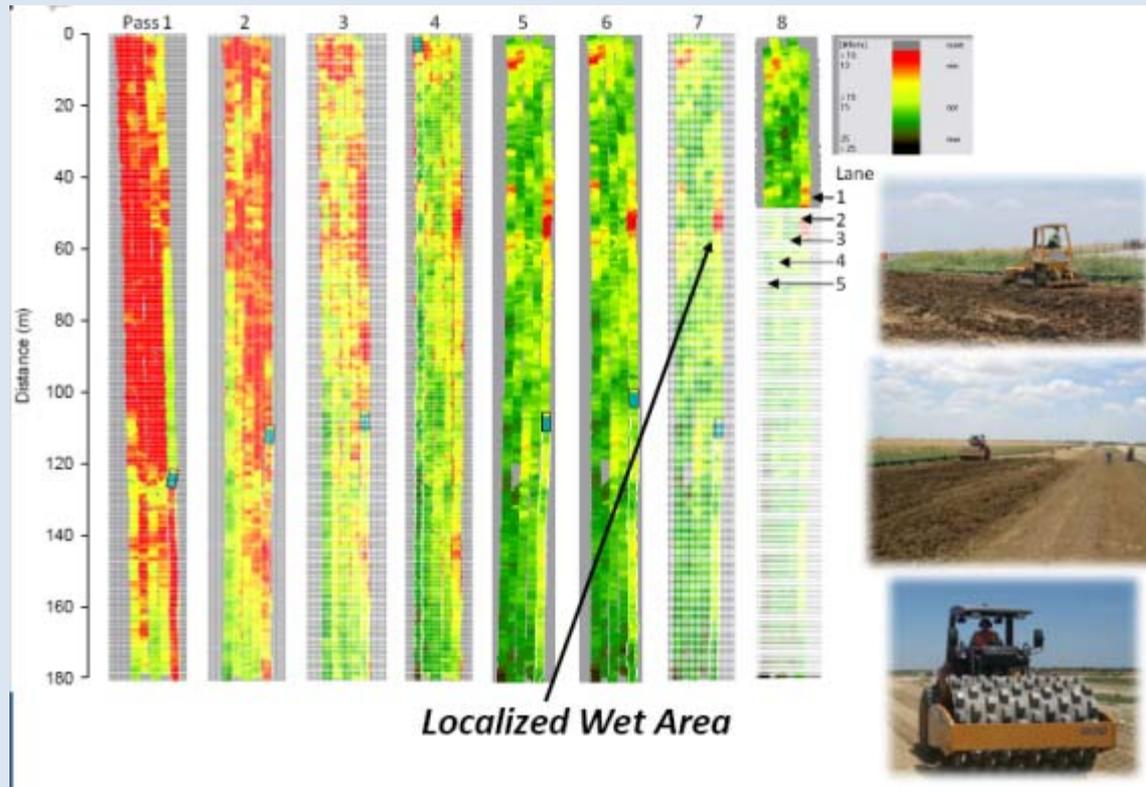


# Intelligent Compaction (IC)

- Implementation of IC Technology
  - Result in more uniform density
  - Reduce the number of passes needed to obtain specification density
  - Valuable QC/QA tool
  - Opportunity to collect and evaluate information for 100% of project area



# Example of IC Technology

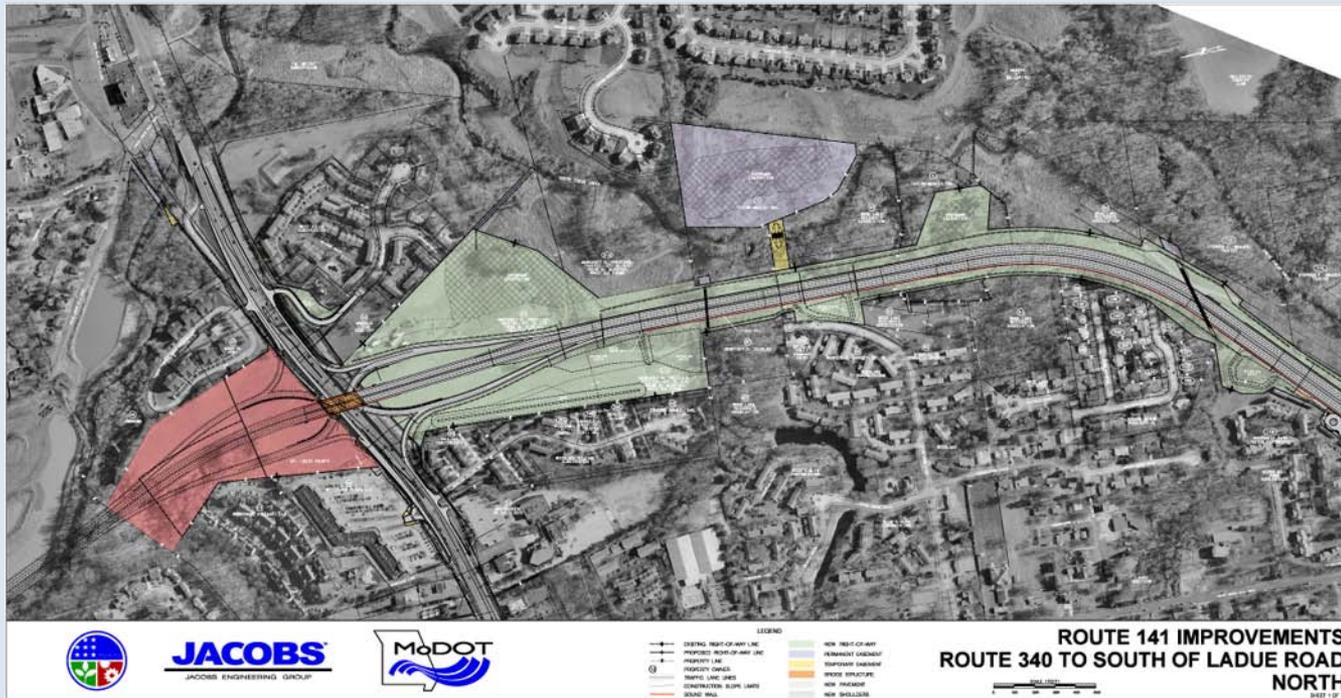


# Route 141 Project History

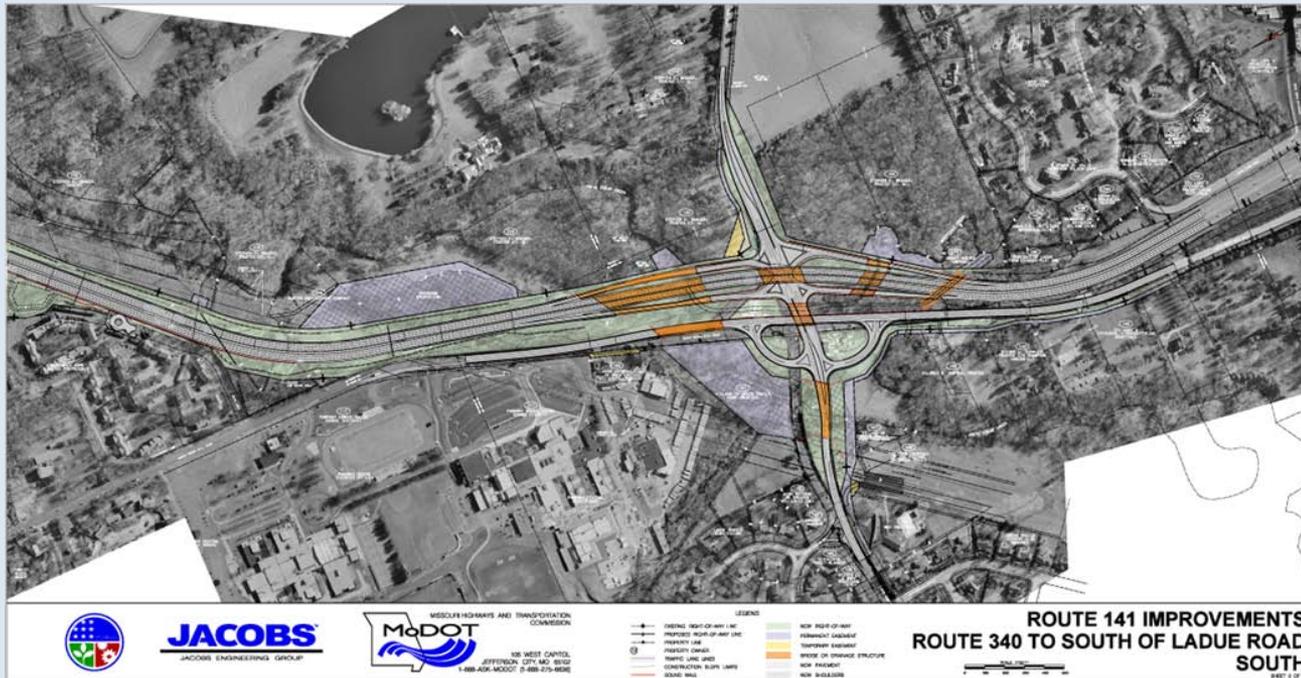
- I-55 to Route 40 completed 2002
- Environmental Assessment approved December 2002
- Construction began Spring 2010



# North Half of Route 141 Project



# South Half of Route 141 Project



# Goals of Route 141 Pilot Project

- Identify suitable QA/QC testing technologies
- Study the impact of contract delivery mechanism on responsibilities on Contractor and MoDOT
- Assess Benefit/Cost of implementing IC into construction projects
- Develop Performance Specifications for IC



# Equipment and Materials tested

## Test Bed Summaries

Test Bed Number	Machine	Notes
1	815F/563	Silty clay – middle of project by old barn
2	815F	Aggregate base -detour @ north end
3	563	Silty clay – Box culvert @ south end
4	815F	Silty clay fill by settlement monitors south of Olive
5	563	Aggregate backfill – MSE wall
6	563	Aggregate base -Tuador frontage road
7	815F	Silty clay – embankment fill on north bridge approach
7A	815F	Expansion of TB7 to north
8	815F	Cut just south of Olivine on north end of project
9	563	Aggregate backfill – MSE wall by bridge (adjacent to TB7)
10	815F	Silty clay – Between boxes on south end
11	815F	Silty clay – By old barn area



# Equipment Used - Caterpillar



# Equipment Used - Caterpillar



# Test Trailer



# Test Bed



# Test Bed



# Operator view of IC



# IC Monitor in Cab



# Contractor Reactions to IC

- I like the technology. It helps me know where to focus more compaction work is needed as well as knowing when it is good
- It could speed up operations by not having to guess on what is going to pass



# Contractor Reactions to IC

- I like the concept if the results correlate with the acceptance criteria
- It could eliminate nuclear tests on the contractor QC plan



# Contractor Reactions to IC

- Next thing to be involved with new tests I find it interesting
- It could save time and money by knowing when the soil passes. I would love to eliminate the nuclear testing



# Contractor Reactions to IC

- Great learning experience with the new technology and approaches. I liked being part of the whole experience
- It could save time. With the nuclear test you actually test a very small area versus the larger area with the IC equipment.

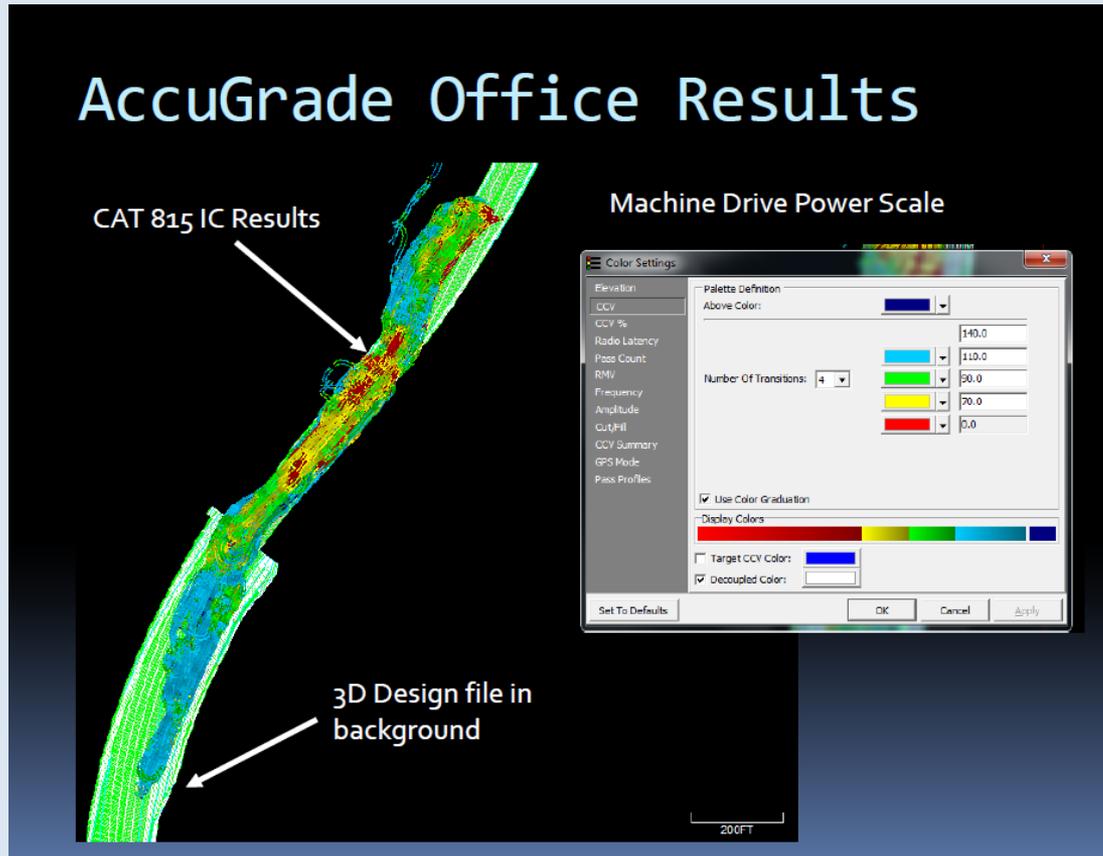


# Contractor Reactions to IC

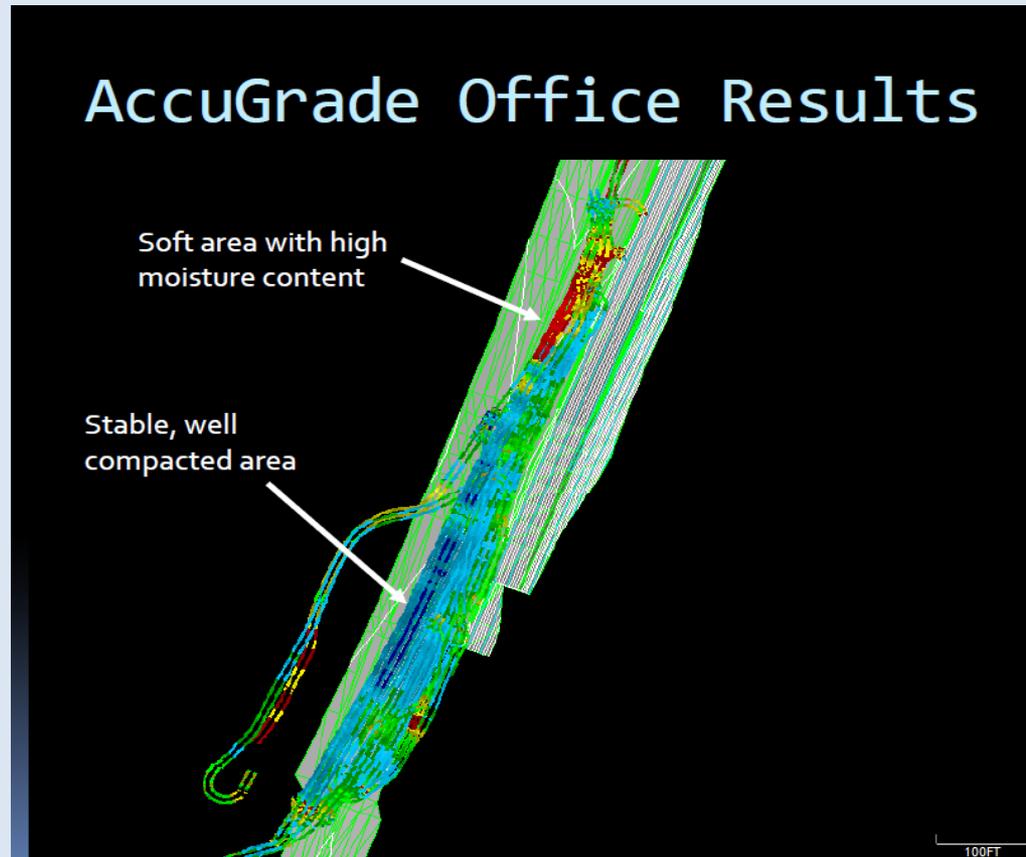
- Good experience. Good to know what compaction results are as you roll. A nuclear test could pass a short distance away could fail.
- The IC roller could replace QC nuclear testing. Also, with the IC roller you can test the rock backfill at the MSE walls which is not tested now.



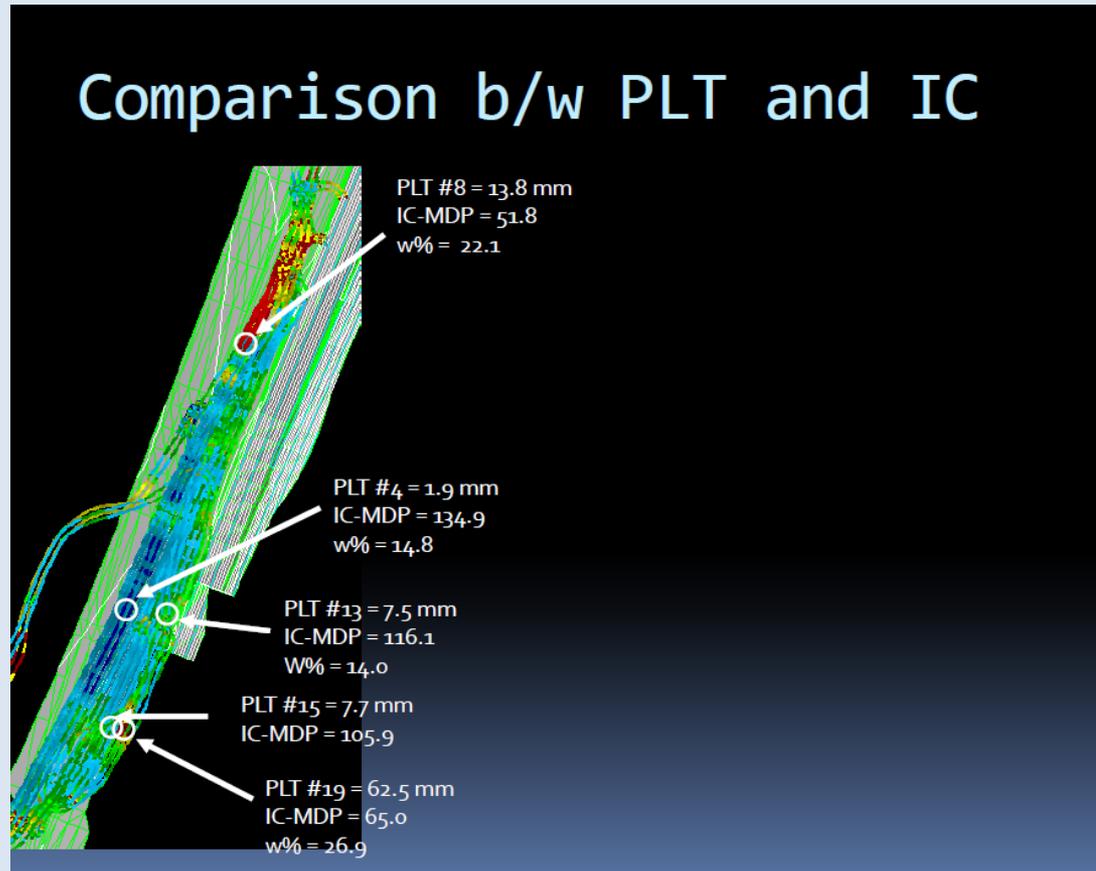
# IC Results from Route 141



# IC Results from Route 141



# IC Results from Route 141



# Technology Transfer Intelligent Compaction Consortium (TTICC)

- Serves as a forum for exchanging technical information and provided opportunities for future collaborations.
- Pooled fund kick-off meeting December 2010
- Updated and prioritized the IC/CCC technology research and implementation needs road map.
- Developed list of key products that needs to be developed



# Intelligent Compaction Research/Demonstration and Production Projects in United States

Technology Transfer Intelligent Compaction Consortium (TTICC) – TPF-5(233)

1<sup>st</sup> Annual Workshop, December 14-15, 2010, Des Moines, Iowa

(Prepared by David J. White and Pavana KR. Vennapusa)

## States DOTs involved in Research/Demonstration

1. California (1)
2. Colorado (2)
3. Delaware (1)
4. Florida (3)
5. Georgia (1)
6. Indiana (2)
7. Iowa (4)
8. Kansas (3)
9. Maryland (2)
10. Minnesota (6)
11. Mississippi (1)
12. Missouri (1)
13. New York (1)
14. North Carolina (1)
15. North Dakota (1)
16. Oklahoma (5)
17. Pennsylvania (1)
18. Texas (4)
19. Virginia (2)
20. Wisconsin (4)

## Full Scale Production:

1. Iowa (3)
2. Minnesota (5)

Note – Number in the parenthesis represent the number of field projects.

