Intelligent Compaction
I-94 Project Highlights

Bernie Southam – NDDOT
Bryce Wuori – Northern Improvement

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I-94 Project Highlights
Presentation Overview

- Project Scope
- Project Requirements
- NDDOT & Intelligent Compaction
- Equipment Used on Project
- Project Results and Data
- IC Drawbacks
- Operator Benefits
- Contractor Benefits
- Owner Benefits
Project Scope

NDDOT JOB #10 (I-94 Concrete and Asphalt Repairs)

- 5.9 Miles Through Bismarck
- Grant Marsh Bridge to 1 Miles East of Exit 161 (Oasis Truck Stop)
- 13 On/Off Ramps
- Approximately 42,000 Tons of Super pave FAA 45 Asphalt
- Work to Take Place at Non-Peak Traveling Times
- Monday through Saturday (6:30 PM to 5:30 AM)
- Sunday (All Day)
- 90% of Project Paved in Night Conditions
- 1.5” Leveling Course
- 1.5” Wear Course
Project Requirements

SP 348 (14) Intelligent Compaction for hot mix Asphalt (HMA)

- Rollers
- GPS
- Work Plan
- Training
- GPS Calibration
- Roller Operations
- Equipment Malfunctions
- Data Submittal
- Data Analysis Software
- GPS Rover
Project Requirements

Super pave FAA 45 Asphalt
  • Modified PG 64-28 AC Oil
  • 2 cores per Sub lot
  • Average of 2 cores

Required Density of 92%
  • Both lifts of Asphalt
IC Work Plan for IN-1-094(179)156

Project Name: NDDOT: IN-1-094(179)156

Date: March 21, 2017

Attn: Mr. Bernie Southam

Project Engineer - NDDOT:

Machine Specifications

Roller Type and Make
- Caterpillar CB66B
- Caterpillar CB68B
- Caterpillar CCS7
- Caterpillar CW16

Roller Dimensions and Weight
- Caterpillar CB66B
  - 84” Double Drum/Max Weight 32,504 lbs.
- Caterpillar CB68B
  - 84” Double Drum/Max Weight 34,789 lbs.
- Caterpillar CCS7
  - 67” Single Drum/Operating Weight 16,120 lbs.
- Caterpillar CW16
  - 9 Wheel Pneumatic/Base Weight 11,464 lbs./Max Weight 33,059 lbs.

IC Technology Specifications

Vendor
- Trimble

Model Number
- Trimble CCS900

Data Output
- .jas files upload every 5 minutes to Trimble Connected Community (Cloud Service), and are used in VisionLink 3D Project Monitoring application.
- Users with access to the VisionLink 3D Project Monitoring account can export Production data in cell grid format to a .jas file for import to Vela. (see attached figure 1 for data sample file)
Project Requirements

- Data File Types:
  - .CDV (Comma Delimited Value)
  - .itm (Trimble Transculation Model) - Final Surface Ax - Built data

Temperature Measurement System
Trimble IC Smart Technology

Number of IC Rollers
- Total of 4 IC Rollers can be in operation at same time
  - Caterpillar CB66B
  - Caterpillar CB44B
  - Caterpillar CCS7
  - Caterpillar CW16

Personnel Trained to work on IC System and Data Analysis
- Bryce Wuerth (Northern Improvement Company, PM/Estimator MPM)
  - IC/GPS Manager and Data Analysis Design Manager
  - Will Design and be in charge of transfer data to NDDOT on daily basis
    or when requested
  - Review and submit IC Data and Maps to NDDOT representatives
  - Manage everyday IC operations in field and in office
  - Nuclear Density Technician for (CMV) Setup and Calibrations
- Nathan Saaenborg (Northern Improvement Company, PM/tech)
  - IC/Field Manager and Data Analysis Technician
  - Will be in field checking control, equipment operations and data
    collection processes in real time
  - Site Setup and Data Analysis
  - Nuclear Density Technician for (CMV) Setup and Calibrations
- Dustin Grant (Tech Specialist, SITETECH Dakota/Butler Cat) (Bismarck, ND)
  - Machine and site setup
  - Corugation Meter Value(CMV) setup
  - SITETECH technology representative/specialist
- Kasey Erickson (Butler Cat, Equipment Sales/Specialist) (Bismarck, ND)
  - Machine setup and inspection
  - Machine Training and Technology Training
  - Butler Cat Equipment representative
NDDOT and Intelligent Compaction

Why the NDDOT is interested in Intelligent Compaction

- Get a uniformly compacted road
- Future Maintenance cost reductions (Less Patching)
- Smoother more dense roads from proper compaction methods
- CMV numbers and Data from IC is useful in locating areas that appear to have lower compactions values
- Does not eliminate use of nuclear gauge on project it is tool used by the contractor to determine their rolling patterns and timing for a better end product
NDDOT and Intelligent Compaction

NDDOT & Intelligent Compaction

- NDDOT does not use the CMV values to determine the pavement density pay factor
- Raw data files are very large and contain more than 100,000 rows of information
- As with any product the results are dependent on how well the contractor understands the information and how to use it
- Compaction still measured by field cores and compared to Maximum Theoretical Density
- Areas with poor cell phone coverage may not be able to use the VRS IC process to get needed data
Equipment Used on Project

IC Rollers
- Cat CB66B
- Cat CB68B
- Cat CW16
- Cat CCS7

GPS and IC Tools
- VRS
- Trimble IC Smart Technology
- Machine Sensors and Systems
- CB 460 Screen
- Vision Link
- Tsc3 Data Collector
- Nuclear Density Gauge
## Project Results and Data

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<th>CellN_FT</th>
<th>CellE_FT</th>
<th>Elevation_FT</th>
<th>Design Name</th>
<th>Mach</th>
<th>Speed_m ph</th>
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<th>TotalPasses</th>
<th>Lift</th>
<th>LastCMV</th>
<th>TargCMV</th>
<th>LastFreq _Hz</th>
<th>LastAmp _mm</th>
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Project Results and Data

What is CMV

- CMV is a Calculated Measured Value
- CMV is a dimensionless unit
- CMV is a stiffness measurement
- Look for consistency in this value
- CMV is NOT DENSITY!!!!
- Measures Frequency's and G forces
- How hard is that drum hitting the Material
Project Results and Data

Intelligent Compaction I-94 Project Data Overview

- Compared over 117 Core Density Tests to IC Data collected
- Used IC Data from core locations in field (Coordinates)
- CMV (Compaction Meter Value)
- CMV at set at 50 = 94-94.5% Density
- CMV average for project was 47.34 or 93.5-94% Density
- Project required a 92% Density

<table>
<thead>
<tr>
<th>Date</th>
<th>CMV Value</th>
<th>Core Value</th>
<th>Expected Core Result</th>
<th>Value Difference Core Vs Expected</th>
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<td>47.34</td>
<td>93.42</td>
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Project Results and Data

- Consistency = Smoothness
- 2 Grind Locations (Headers)
- Average Standard Deviation 7.0
- Average 56 Range
IC Drawbacks

- Initial Investment Costs
- Training Time and Costs
- New Technology Glitches
- Collects Data up to 1.5 M in Ground
- Immense Amount of Data Collected
- Understanding and Evaluating the Data
Operator Benefits

- Operator Awareness
- Eliminates Operator Error (Paints a Picture)
- Temperature Mapping (Too Hot or To Cold)
- Pass Count Mapping
Contractor Benefits

- Quality Control and Management
- Testing Costs
- Efficiency
- Consistency in Rolling Patterns
- Consistency = Smoothness
- Density Incentives
- Smoothness Incentives
- Can be Used in other Applications
  - Subgrade
  - Granular Base
- Can be Used in other Applications
- Subgrade
- Granular Base
Owner Benefits

- Quality Assurance and Management
- Better End Product
- Smoother Roads
- More Dense Asphalts
- Testing Costs (Less Cores)
- Data Collection
- Data Evaluation
- Complete Picture of Entire Project
Why IC and Technology is Important

- Competitive Edge
- Efficiency Tool
- Project Cost Reductions
- Flexibility/Diversity
- Quality Control Management
- Work Smarter and Not Harder
- Ahead of the Change Curve
- Technology is the key to success
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