Brian E Girouard, Milling-Paving-Compaction Specialist
Civil Engineering & Construction – Americas
Trimble Navigation Ltd
Cell: 702-683-4684
Email: brian_girouard@trimble.com

Kevin T Garcia, Paving/Specialties Business Area Manager
Civil Engineering & Construction
Trimble Navigation Ltd
Office: 303-635-8834
Email: kevin_garcia@trimble.com
http://construction.trimble.com/sitech
Notable/Award Winning Projects

- Telluride CO Airport Project with Kiewit (2009)
- New St-George UT Airport Project with Western Rock (2010)
- Port Mann-Hwy 1 Project in Vancouver BC with Kiewit (2011)
- Circuit Of The Americas (COTA) F1 Track in Austin TX with Austin Bridge & Road (2012)
- Western Wake Expressway Raleigh NC with Lane (2012)
- Colorado Springs CO Peterson AFB Runway Project with Kiewit (2013)
- Honolulu HI Reef Runway Project with JAS W Glover (2013)
- Bowling Green KY National Corvette Museum Motorsports Park (Corvette Test Track) with Scotty’s Contracting (2014)
- Quebec Ministry of Transportation (2015)
- Bogota El Dorado International Airport (2016)
- US Bank NFL Vikings Stadium in Minneapolis MN with Park Construction Company (2016)
  - 2016 National NAPA Award Winner!
- Numerous FHWA/State DOT Intelligent Compaction Projects
Paving Challenges
Typical Paving Challenges

- Material yields
- Cost of Materials
  - Cost of AC
  - Limited aggregate resources
  - Transportation and Production Costs
- Project Deadlines
  - Limited access to areas of the project due to roadway or airport traffic control
  - High penalties for going over
- Additional paving/levelling course
- Additional grinding/milling
  - After paving is completed and to meet smoothness spec
Typical Paving Challenges

- 5 specific challenges:
  1. Thickness
  2. Elevation Grade
  3. Cross-slope or Straight Edge
  4. Differential Compaction/Longitudinal Waves (Smoothness)
  5. Compaction/Density
    - PLEASE NOTE: Top 4 are achievable with 3D Paving!

- Traditional methods require
  - Placing, Grading and Maintaining “piano wire”/stringlines
  - Managing Trucks and Machines around placed stringlines
What are the traditional methods?

- Placing Stringline or Wire
- Grade paint marks on surface
- Estimating/Guessing?!!?
Machine Control Positioning
Machine Control Positioning

- **1D**
  - Measuring elevation
    - Level Laser
- **2D**
  - Measuring elevation and slope
    - Slope Laser
    - Slope sensor
    - Sonic tracer(s), Averaging Beams
  - Wheel for measuring stationing
  - Material thickness, from ground – up
  - *NOTE: If the technology references the ground for elevation, it is not 3D!*
- **3D**
  - Tracking and measuring of a moving target for x, y and z (Easting, Northing, Elevation) coordinates
    - Optical robotic total station
    - Or a satellite based navigation system
  - Uses an engineer design, from top – down
Machine Control Positioning

• 1D

Flat or Level (no slope)

Laser Plane

Laser Transmitter

Reference Elevation
Machine Control Positioning

- 2D

Elevation (e.g.: Sonic)

Slope (e.g.: Slope Sensor)
Machine Control Positioning

• 3D
Robotic Total Stations
Milling and Paving Machine Control Applications
- 3D Milling
Profile 3D Milling - Only mill what is needed

- Accurate Vertical Control!
  - Remove more material
  - Remove less material
  - Longitudinal waves in the road
  - More consistent asphalt structure
Variable Depth 3D Milling - Mill complex designs

- Variable depth and slope milling enables milling of:
  - Transitions
  - Super-elevated curves
  - Variable drainage slopes
  - Control and Manage your Material Quantities!
Increased Smoothness & Decreased asphalt usage

The issue of differential compaction when paving:

3D milling corrects the issue:
Increased Smoothness & Decreased asphalt usage

- Asphalt filling of low spots (e.g.: Leveling Course)

- 3D Milling minimizes asphalt usage
- More consistent and better asphalt structure
Milling and Paving Machine Control Applications
- 3D Paving
Paving Terminology

- 2D Paving – controlling grade (elevation/thickness) and slope independent of a model
  - 2D is Ground-up
  - 2D Systems lay a constant thickness over the base
  - **NOTE:** If the technology references the ground for elevation, it is not 3D!
- 3D Paving – controlling grade and slope at a known position per a design/model
  - 3D is Design-down
3D Paving Applications

- Any project where a contractor uses stringline or wire for elevation grade
- Variable depth and slope paving applications
  - Airports, roads and commercial surfaces
  - Base material (P209, gravel, etc...)
  - Asphalt
  - Roller Compacted Concrete (RCC)
  - Concrete Treated Base (CTB)
3D Paving Applications
Advantages of 3D Paving

- Achieve the highest accuracy and smoothness levels
  - Better material management
- Eliminate the stringlines:
  - Reduce staking labor, downtime and errors
  - Reduce costly rework
  - Finish the project faster
- Pave complex designs
- Use an “Uncompacted Design” to help differential compaction issues
  - For most applications, includes “levelling course” in the same pass
Traditional Methods of Paving

Original Surface with longitudinal road waves

Surface after paving with a traditional 2D system

Surface after rolling: road waves not entirely smooth
Using an Uncompacted Design

Original surface with longitudinal road waves

New road design with compaction factor (e.g. 0.80)

3D paved surface before compaction

3D paved surface after compaction
Managing Differential Compaction

Paving & Rolling
Managing Differential Compaction

This surface represents long longitudinal roadwaves
This is N.T.S and is extremely exaggerated

- If you lay a thicker lift you get more compaction
Managing Differential Compaction

This surface represents long longitudinal roadwaves
This is N.T.S and is extremely exaggerated

- Place the asphalt to the “Uncompacted” Design
  - A little thicker over the low areas

- Rolling will leave a smooth level surface
- Consider using a 3D mill prior to paving!!!
Costs and Savings
What are the Costs and Savings

- What are the project specifications?
- Is the project a mill and fill?
- Are you being paid by the square area or by volume?
- What are the material overruns? 6%? 8%?
- What is the smoothness pay scale factor?
  - 100% pay or deduction?
  - Ride Bonuses?
- Will you drop the mill in the cut and perform the typical “blow and go”? 
- If the project is still uneven after milling, how do you manage quantities?
- Will you be placing a levelling course before mainline paving?
- How long are you responsible for the project after completion (warranty)?
Intelligent Compaction (IC) CCS900 Asphalt (ACOM) Solutions
Pass Count Mapping

*Avoid over or under-compaction*

- Displays pass count maps, allowing operator to track where pass count target has been met
- Pass count mapping allows you to monitor the number of passes over an area and adjust your effort
Temperature Mapping

*Know exactly where to be for ideal compaction timing*

- When installed with two optional IS310 Infrared Sensors, CCS900 maps the surface temperature of the mat.

- Displays temperature maps, allowing operator to judge his time window for compaction across the surface.
CMV – Compaction Meter Value

*Understand your compaction*

- CMV is an accelerometer based sensor that gives the operator an indication of the stiffness and consolidation of the material below the roller.
- The value may be correlated to the accepted static density test being used on the project.
- Takes into account the level of compaction taking place with respect to the vibratory effort, roller size, weight, speed, vibratory frequency and amplitude of the drum.
CMV (Compaction Meter Value)

- Trimble CM310 Accelerometer that measures stiffness of material to ~1m deep
  - Important to note that it is *not* a measure of density
Machine to Machine Mapping

- Map sharing feature enables 2 or more machines to share mapping data in real time
- Machines able to work from a common updated map
Questions?
THANK YOU!