Trimble

FEBRUARY 2018

Trimble PCS900 3D Milling & 3D Paving

Presenter

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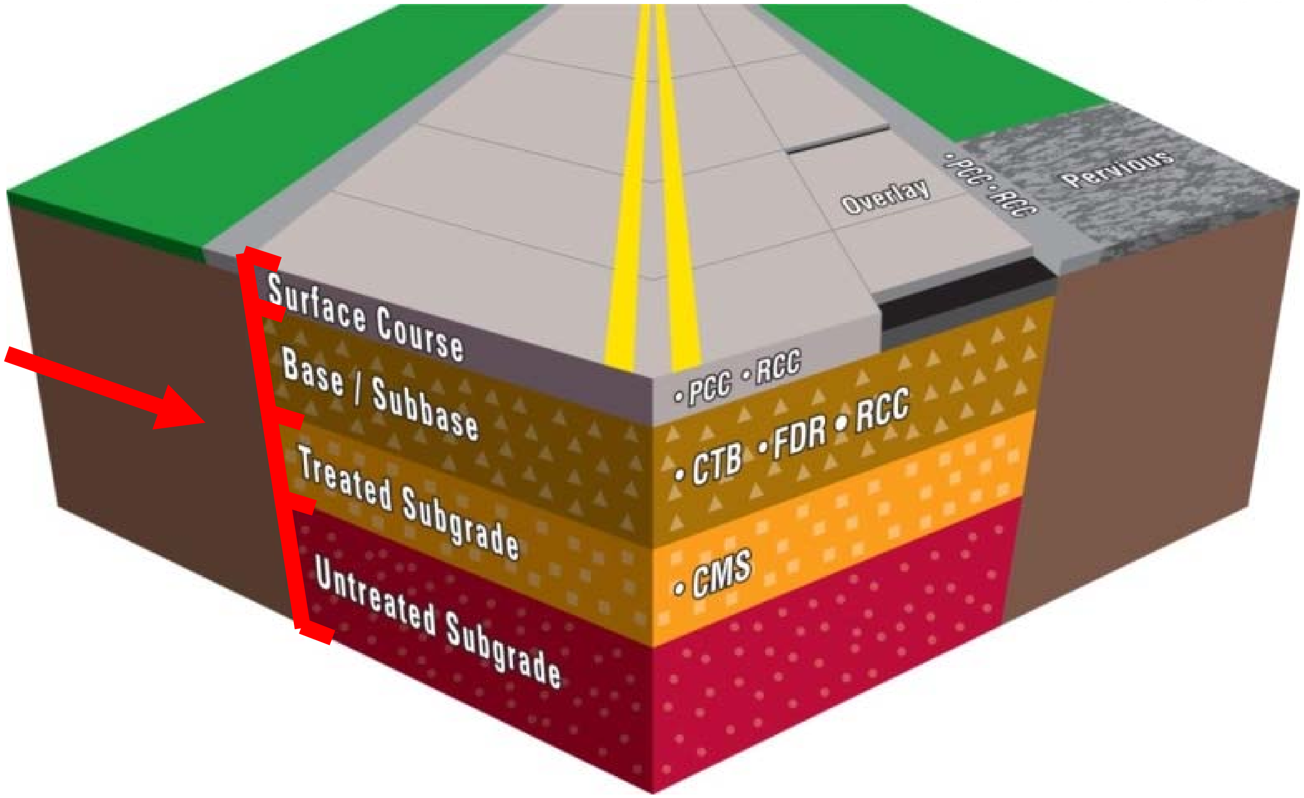
- Sitech Michigan

Why use 3D Milling and 3D Paving?

To build better pavement Structures!!!

Sample Engineering Specifications

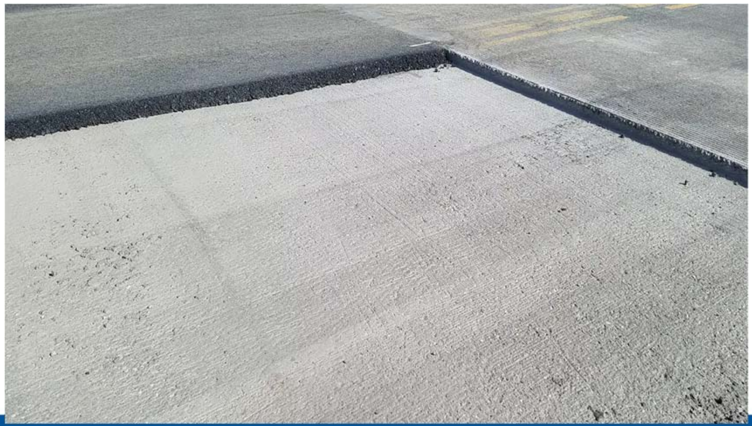


2D and 3D Milling-Paving Terminology

- 2D Milling-Paving – guidance to grade [elevation-thickness] and/or slope
  - 2D is Ground-up
  - 2D Systems typically place a constant thickness over the base
- 3D Milling-Paving – guidance to grade and slope at a known position using a design/model
  - 3D is Design-down and does not use the existing surface for guidance

"Traditional" 2D Milling Method: Non-Graded Surfaces

3D Milling Method: Graded Surfaces



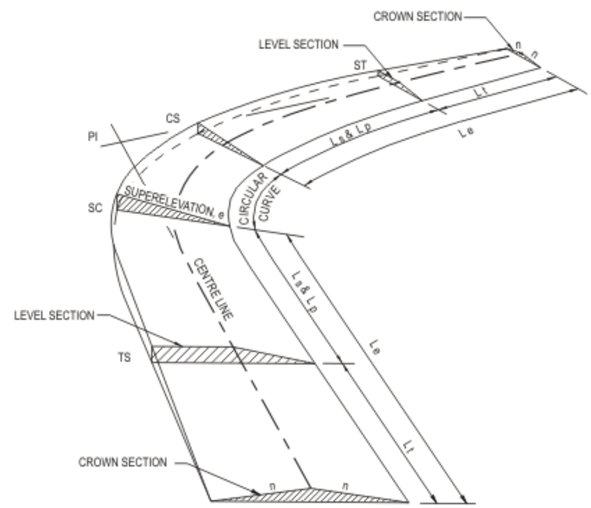
PCS900 3D Milling – Making Grade

Why 3D Mill?

- Increased production, lower cost
  - Only mill where needed
- Increased smoothness
  - Remove longitudinal waves
- Decreased asphalt usage
  - No need to fill in low spots [leveling course]
- Change/Fix Cross-Slopes
  - New State/Federal Specs
- Mill complex designs
  - Transitions, supers, drainage, etc.
- No Stringline or wire required
  - Reduce costs
  - Better truck/traffic management
  - Safer

Why 3D Mill? – Con’t

- Variable depth and slope milling:
  - Remove more or less material as per project specifications
  - Provides uniform surface for pavement

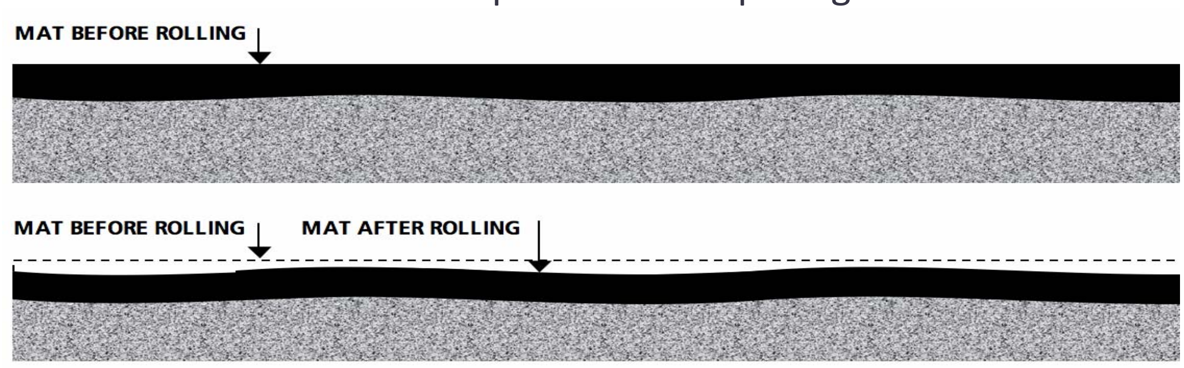


Guide Policy for Geometric Design of Freeways and Expressways - NAASRA 1976

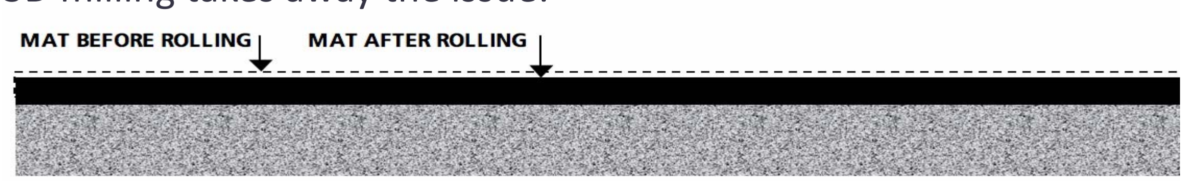
Other Advantages of 3D Milling

- Increased Smoothness

  The issue of differential compaction when paving:

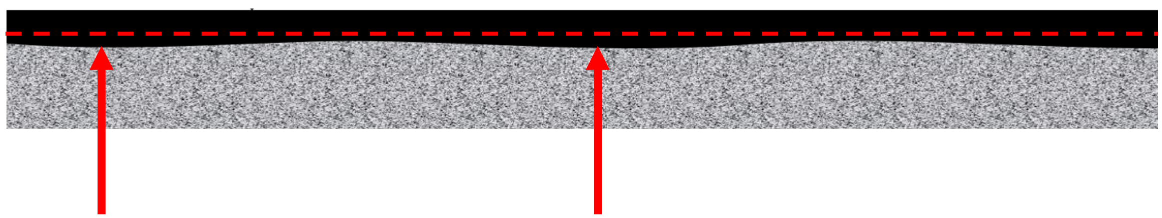


  3D milling takes away the issue:



Other Advantages of 3D Milling – Con't

- Decreased asphalt usage



Asphalt filling of low spots [Levelling Course]

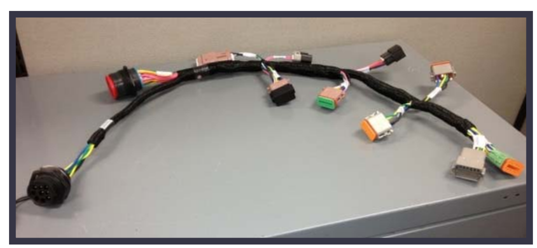
- 3D Milling minimizes asphalt usage

Results of better Pavement Structures using 3D

- Smoother
  - Easier to control vehicles at higher speeds
  - Less impact, especially with heavier loads
- Safer
  - Better drainage, reduce ponding/hydroplaning
  - Better traffic control
    - Quebec Ministry of Transportation increased off-ramp +10km/h [+6mph]
- Longer lasting
  - Lower maintenance costs
  - Better snow removal hence
    - reducing additional wear
    - premature failures from undulating surfaces
- Taxpayers enjoy driving on smooth roads ☺

PCS900 3D Milling – Components

PCS900 On –Machine Components



Control System Overview

PCS900
- 3D Position Sensor
- Relative to design
- Top Down

Up/Down
Left/Right
Corrections

Contact Sensors

Sonic Sensors

Wire Rope Sensors
- 2D Position only
- Ground up

2D OEM Control System

Machine Hydraulics
[Leg Control]

2D System Compatibility

- Wirtgen LevelPro
  - DLS-1 v6.072 or v6.074
- MOBAmatic
  - CAN / PWM
- ROADTEC ACE Grade and Slope
- CAT Grade and Slope

MOBA
MOBILE AUTOMATION

Trimble PCS900 3D Mills – In the Field

PCS900 3D Paving – Making Grade

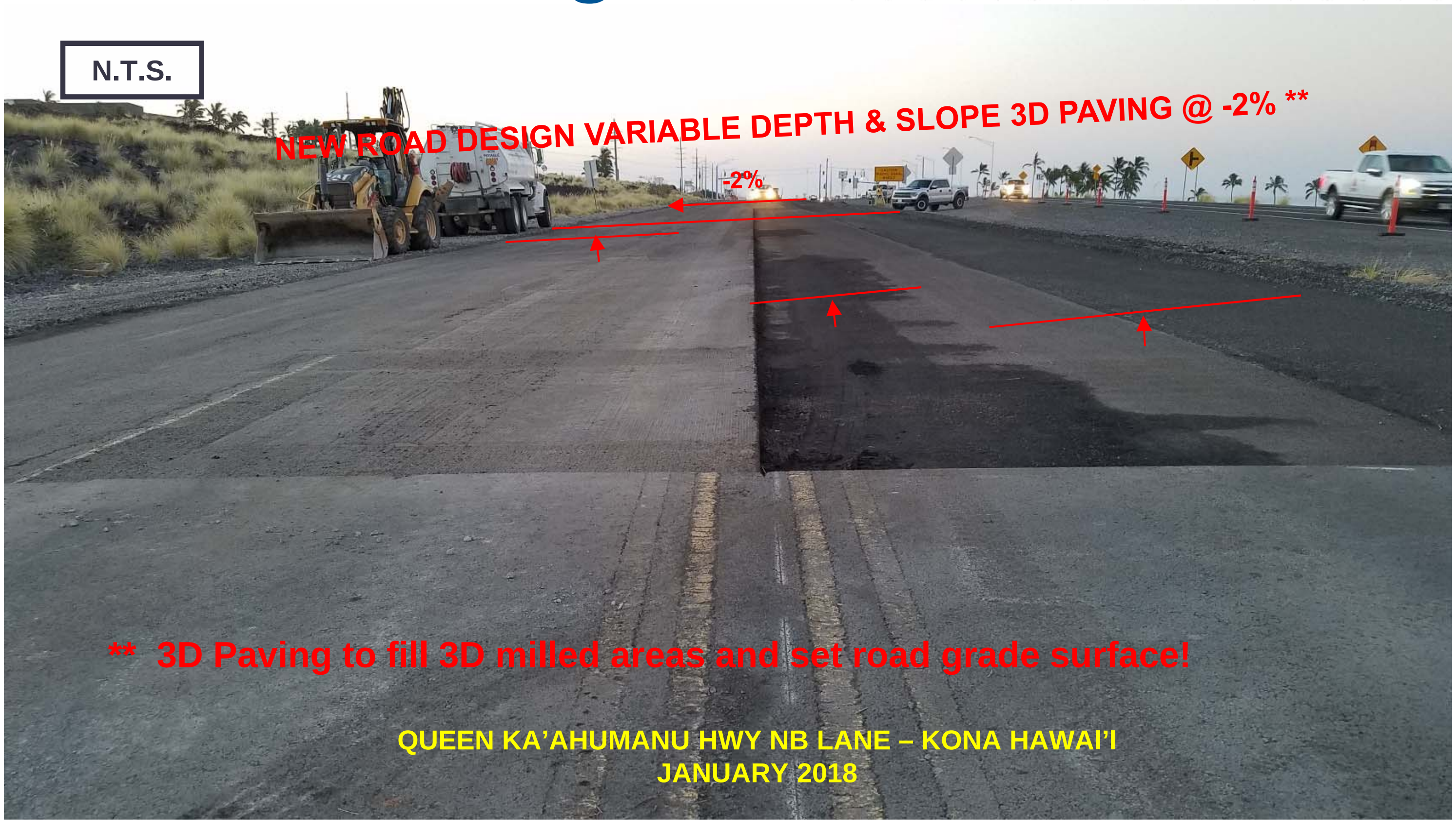
Why 3D Pave?

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

PCS900 3D Paving Applications

- Any project where a contractor uses Stringline, wire or “grade marks” for elevation grade
- Variable depth and slope paving applications
  - Roadways, Airports and commercial surfaces
  - Base material [P209, gravel, etc…]
  - Asphalt
  - Roller Compacted Concrete [RCC]
  - Concrete Treated Base [CTB]

PCS900 3D Paving



PCS900 3D Paving

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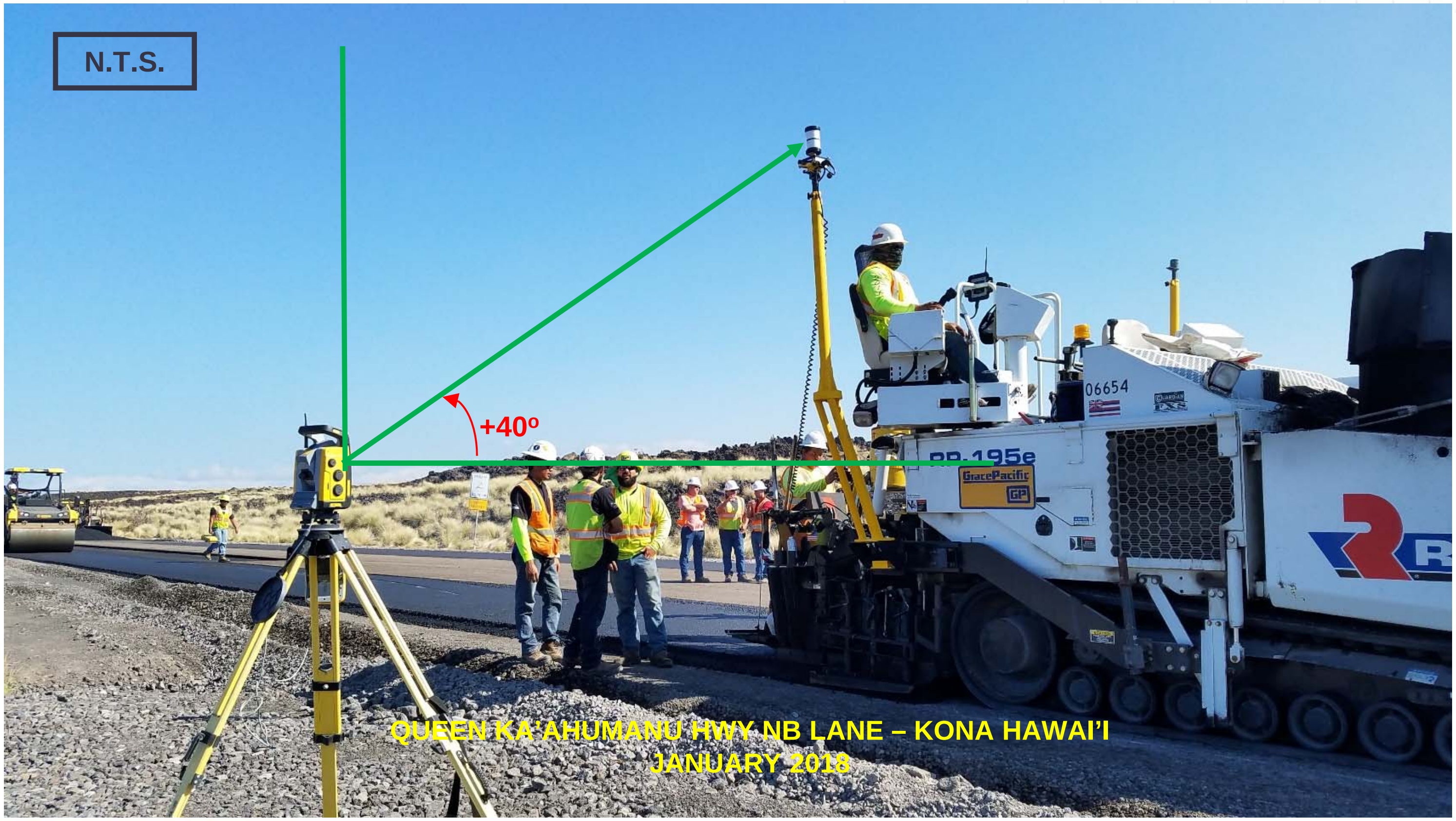
PCS900 3D Paving – UTS Tracking [typ for Corridors]



PCS900 3D Paving – Managing Differential Compaction

Managing Differential Compaction

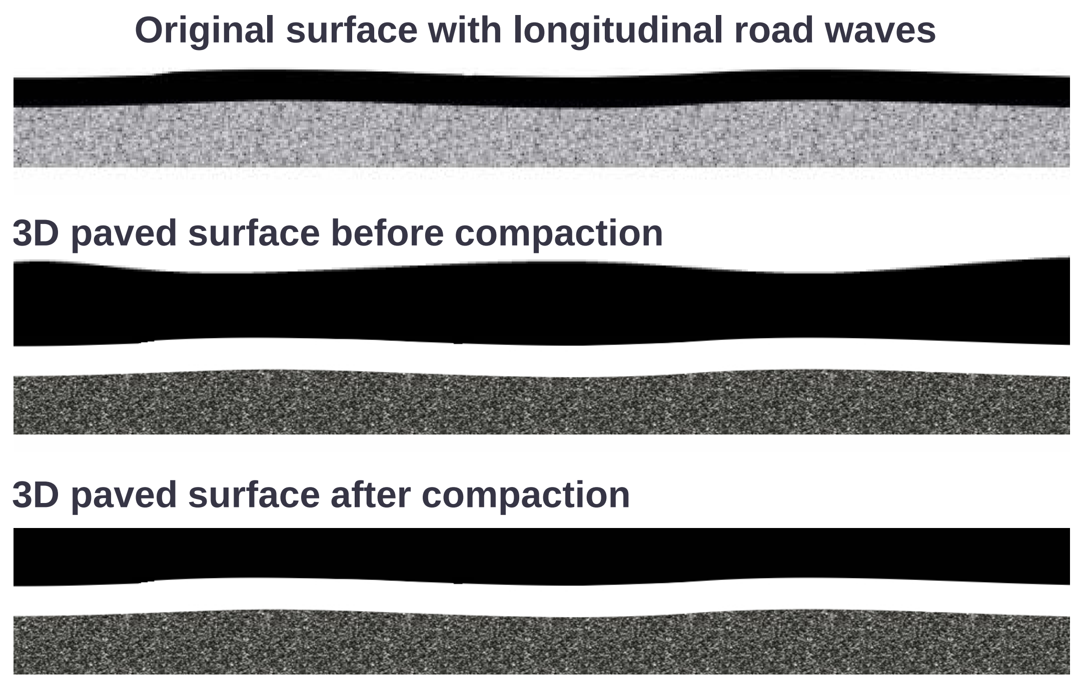
- 3D Designs describe the final finished surface
- 3D AMG systems use vertical offsets to build up to this surface
- Final asphalt lift is designed to finish at this design surface
- If existing paving surface is not to grade or not level, low areas will compact more
  - Paved surface will have longitudinal waves affecting smoothness
- Traditional practices are to place multiple lifts hoping the waves are reduces and/or eliminated by final lift
  - ~60% to +80% of waves reduced per lift

Managing Differential Compaction

- PCS900 can help manage differential compaction
  - Using a PCS Uncompacted Design
- PCS Uncompacted Designs require 3 key components:
  - Existing Surface
  - Design Surface [e.g.: first lift of compacted asphalt]
  - Compaction Factor
    - E.g.: 2” compacted, placed at 2.5”
    - Compaction Factor = 2/2.5 = <u>0.80</u>
- 3D Paving goal is to place “levelling course” at the same time as design grade
  - Compacted material is placed at grade

Using an Uncompacted Design

New road design with compaction factor [e.g. 0.80]



Managing Differential Compaction

Paving & Rolling on a smooth or 3D AMG graded surface

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

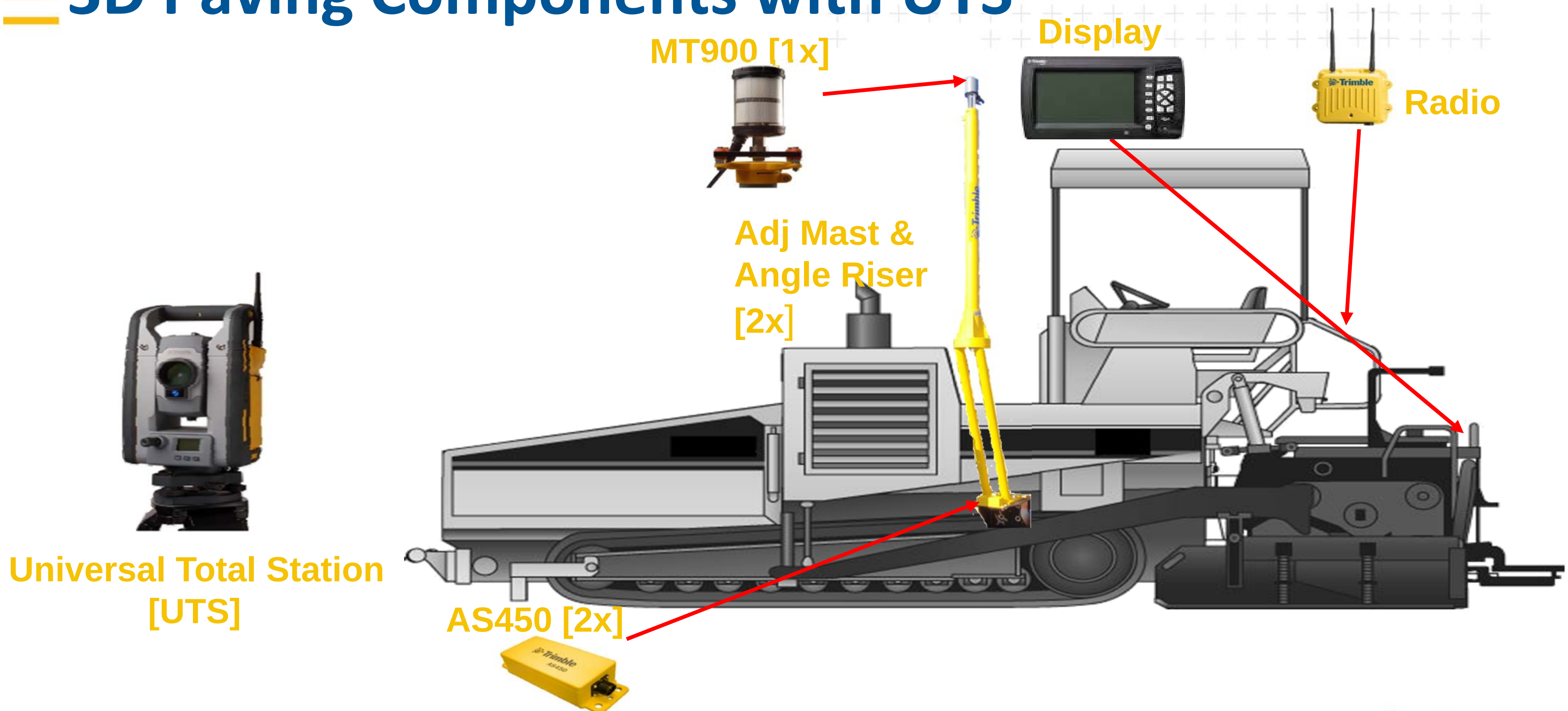
This surface represents long longitudinal roadwaves
This is N.T.S and is extremely exaggerated

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

- Rolling will leave a smooth level surface
- **<u>Consider using a 3D mill prior to paving!!!</u>**

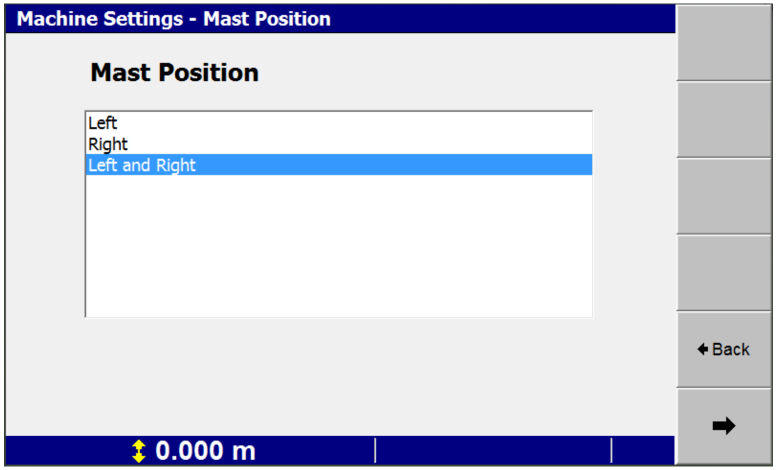
PCS900 3D Paving – Components

3D Paving Components with UTS

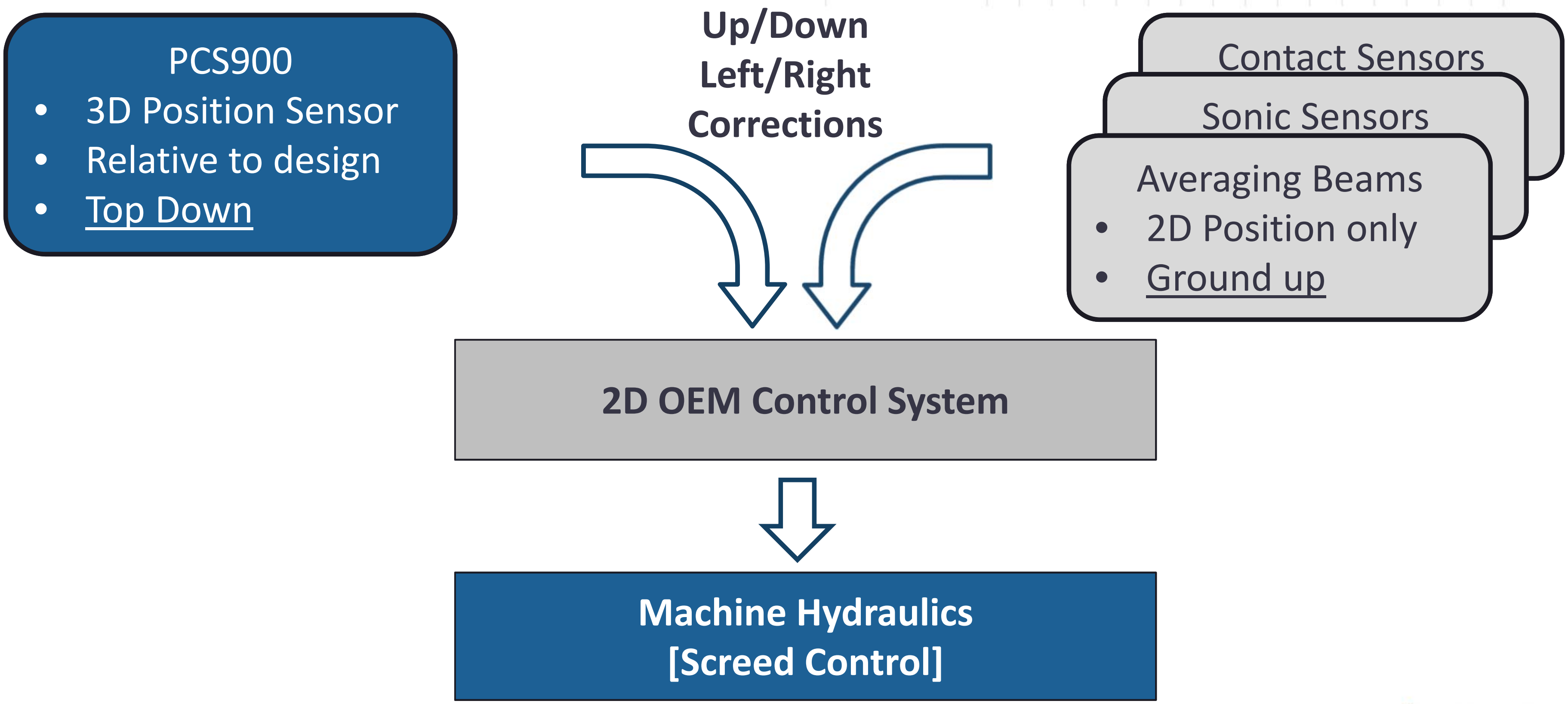


Dual Mast Setup

- Allows measure-up of left and right masts
  - Still only using one side for machine guidance
  - Makes switching over from one side to another fast
  - Same feature that exists on Mills



Control System Overview



2D System Compatibility

- Trimble PCS400 2D
  - V1.22
- MOBAmatic
  - CAN / PWM
- Vogele NiveltronicPlus3D Interface
- CAT Grade and Slope

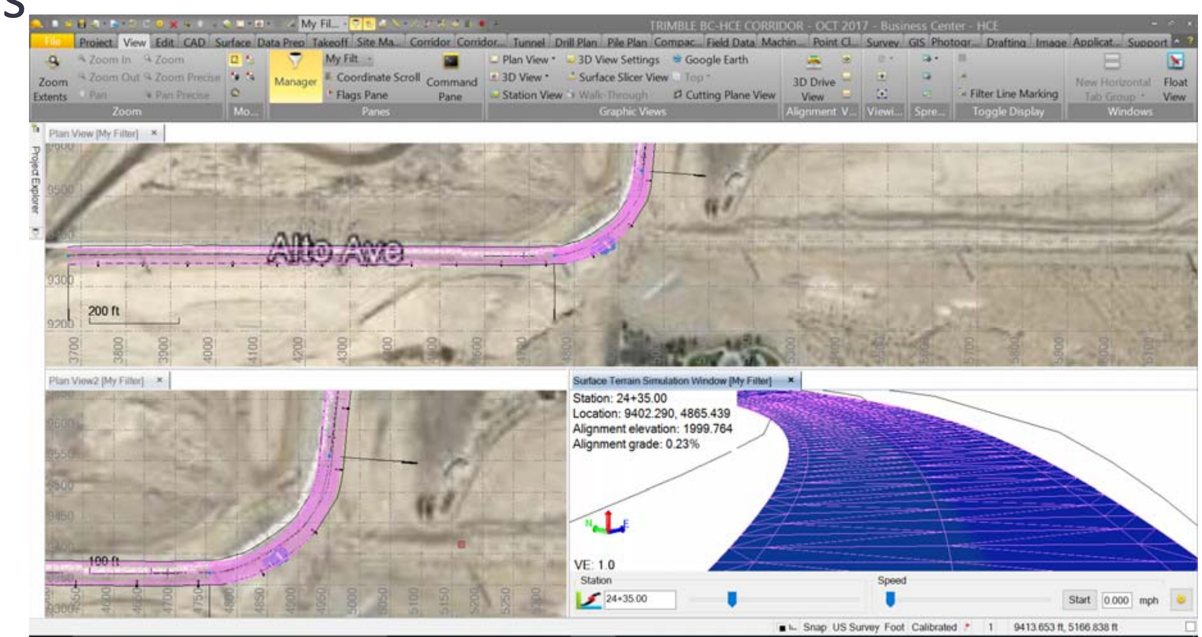
2D
V1.2
2
MOBAmatic
CAN
/
PW
M
Vogele
NiveltronicPlus3
D interface

Trimble PCS900 3D Pavers – In the Field

PCS900 3D – Key Features

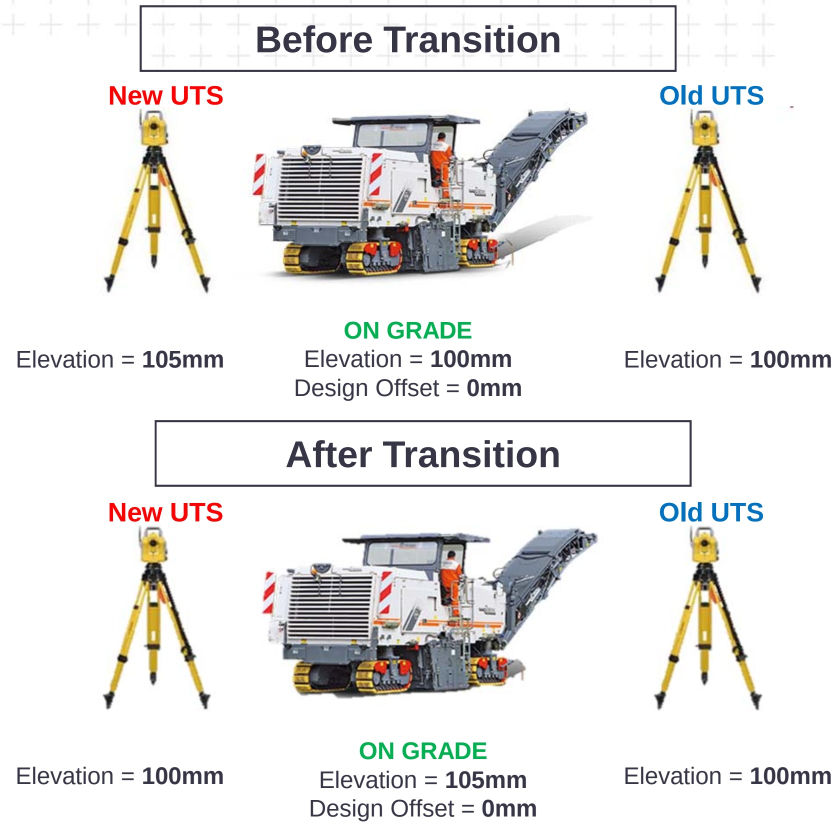
Design Support

- Supports SVL / SVD
- Supports alignments
  - Not required



UTS – Transition Strategy

- Elevation/Horizontal differences are absorbed
- No movement during transition; no “bump”



DECEMBER 2017

Key Ingredients for a Successful 3D Automated Machine Guidance [AMG] Project

Key Ingredients for a Successful 3D AMG Project

- Consult with a qualified manufacturer and supplier prior to the project
- Training and Support from a qualified distributor
  - Plan and prepare for training prior to production on the project
- Contractor is committed in using technology
  - Should have a person on staff to be responsible
  - Product Solutions Investment and an Investment to change how you work
- Contractor follows all machine manufacturer recommendations for operating the machines equipped with Machine Guidance
  - E.g.: Paving By The Numbers, etc… for pavers
  - There is no “magic” button when technology is install, you still need to know how to pave

Key Ingredients for a Successful 3D AMG Project

- Use the correct technology for the project application [s]
  - Is there line of sight for the total stations?
  - Are there any obstructions?
  - High walls? Overpasses? Bridges? Trees? Buildings? Tunnels?

Key Ingredients for a Successful 3D AMG Project

- Use the correct technology for the project accuracy requirements
- How does the 3D technology work with the existing milling or paving 2D technology?
- Machine is in optimum working condition
  - Any wear or "slack" on the machine will affect results
- Consider other machines for machine guidance and not limit to just one. Look at the whole spread.
  - One machine is productive, multiple machines are MORE productive!

Key Ingredients for a Successful 3D AMG Project

- All Instruments need to be checked, cleaned, adjusted, updated with a Certified Service Center
- All Technology [e.g.: Instruments, Sensors, etc…] on the project need to be field calibrated as per the manufacturer's recommendations
- Always check and double check equipment and technology on the project

Key Ingredients for a Successful 3D AMG Project

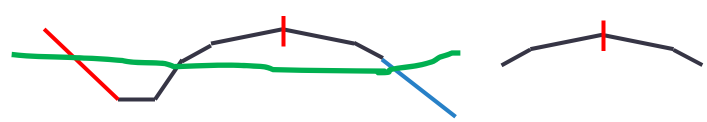
- Project **<u>Survey Control Points</u>** must be accurate
- Must be less than ½ the project specifications
  - Example: Project Spec of ½” [0.012m], Survey Control less than ¼” [0.006m], etc…
  - Contractors may chose to be more accurate than project spec to help manage material yields
- Use a <u>Digital Level</u> system to reduce or eliminate human errors!
- If you are 3D milling or 3D paving, mm accuracy is a must
  - There is no reason or excuse for poor survey control accuracy
- Should be no more than 500’ [150m] apart for Total Station Machine Guidance
  - You need to know the technology ranges and/or limitations
- Surround the project

Key Ingredients for a Successful 3D AMG Project

- Use Digital Level [Vertical]
- Total Station [Horizontal]

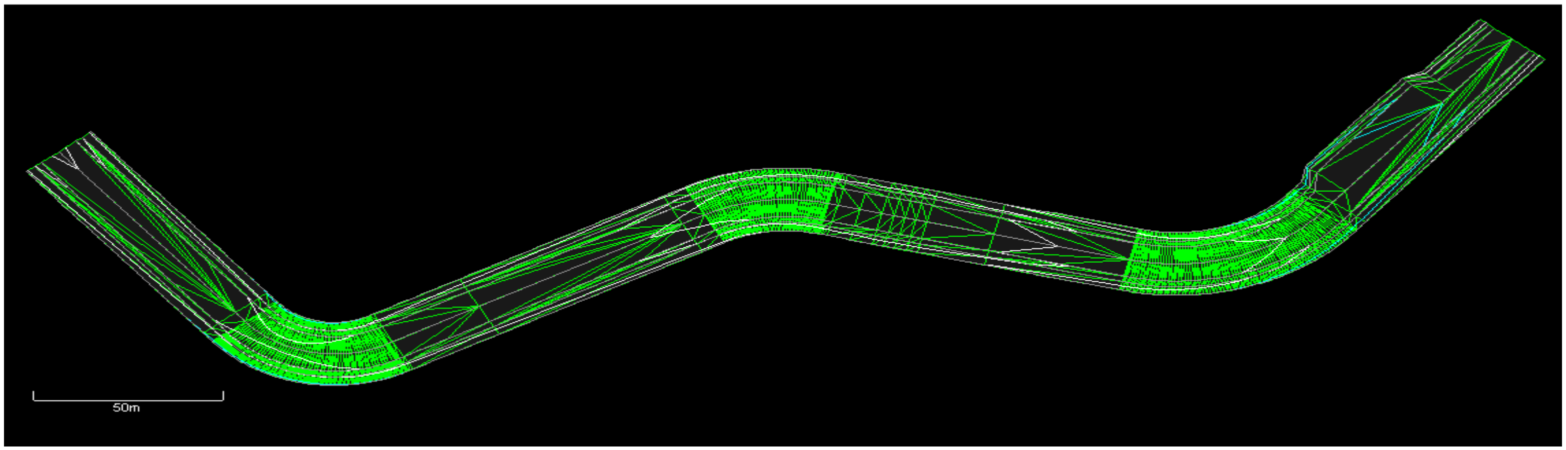
3D Data/Designs – Built for AMG

- Must be Accurate
- Built for Machine Guidance applications
- If building a road/corridor, runway/taxiways, use the design as it was built
  - HAL, VAL, X-Section Templates, Stationing, Superelevations & Widening, etc…
- Build the design as the project will be constructed
  - Subgrade, Finish Grade, etc…

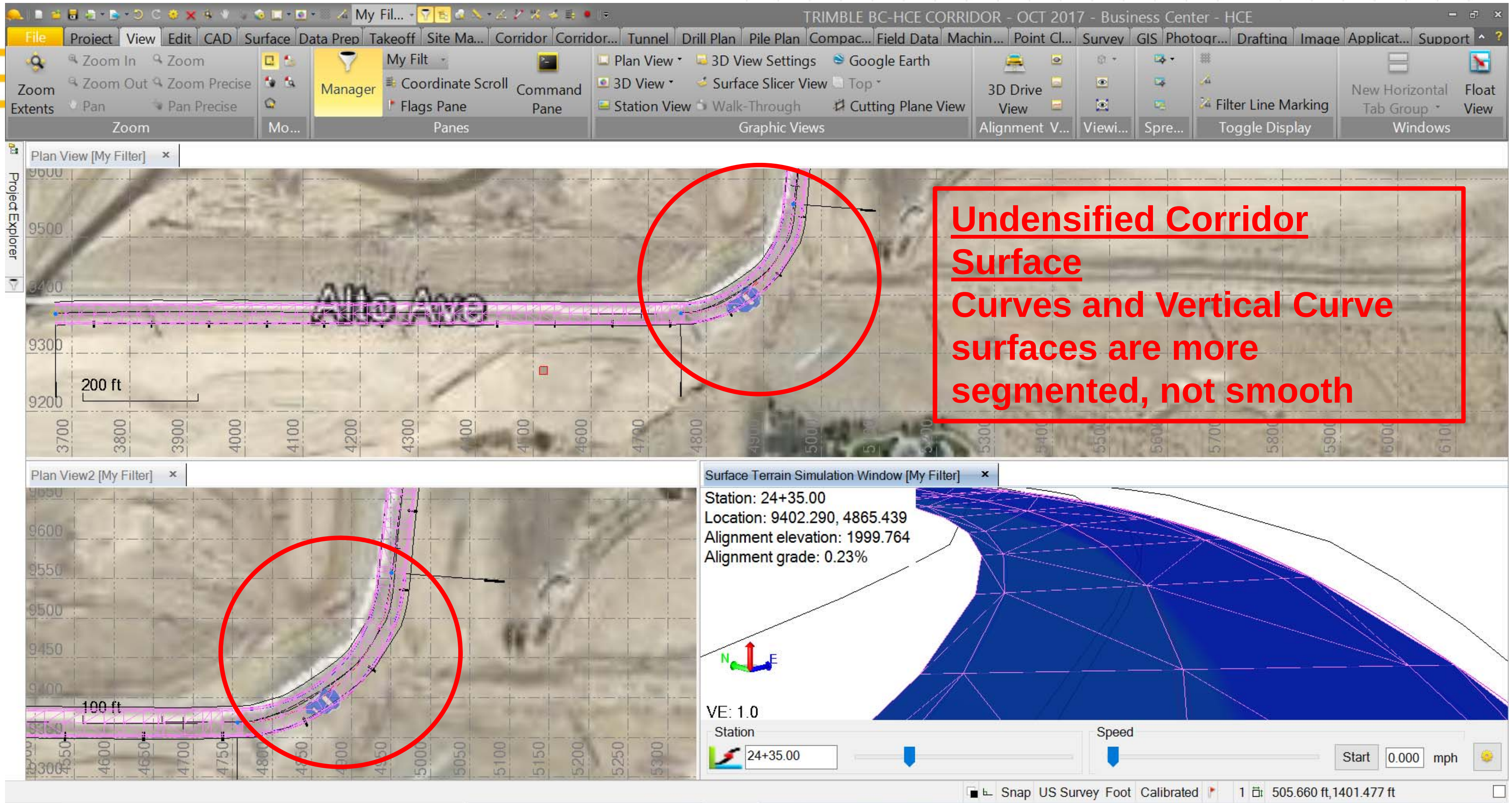


Key Ingredients for a Successful 3D AMG Project

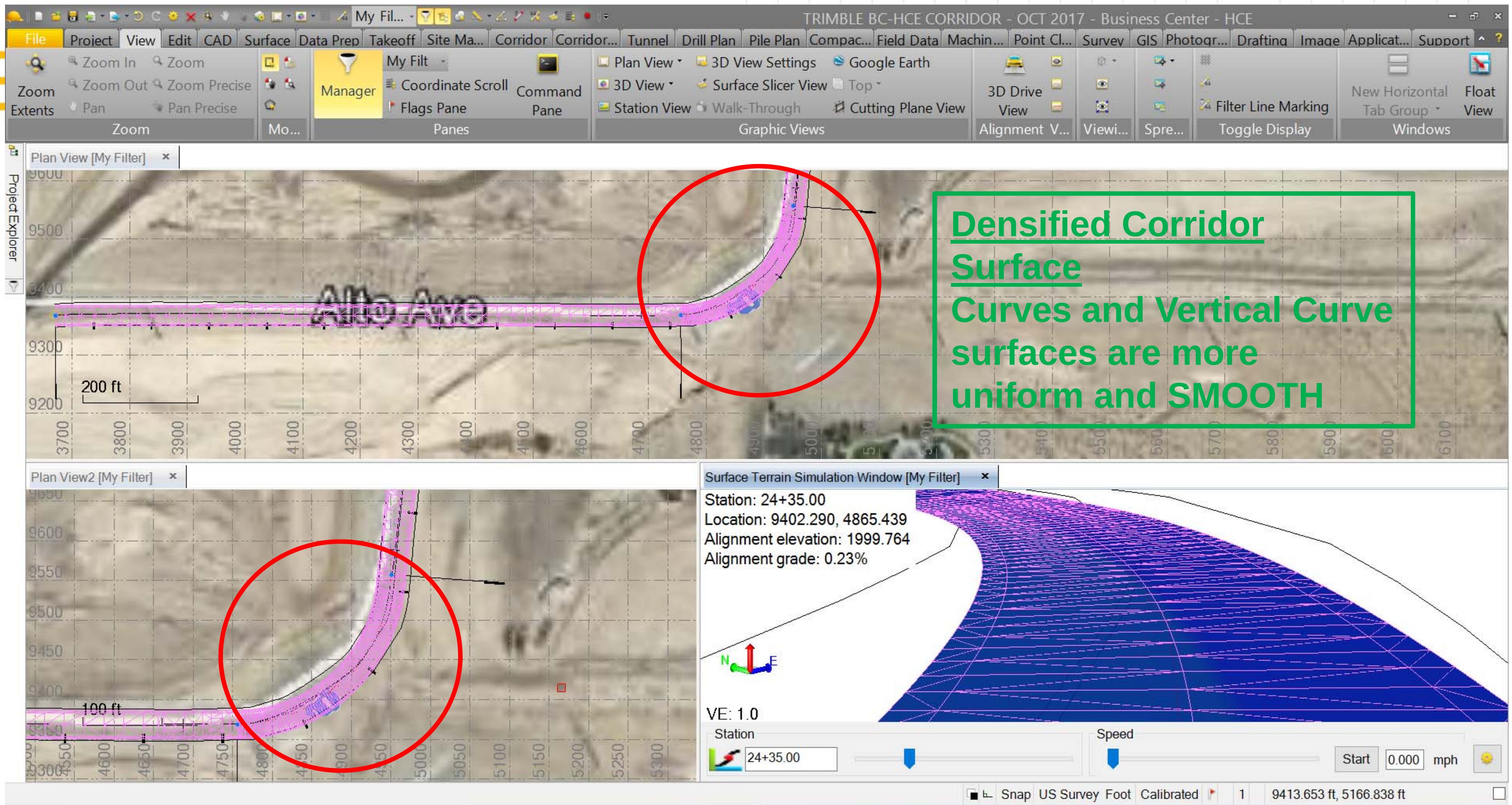
- Optimized and densified for Machine Guidance



- Must meet or exceed IRI/Smoothness Spec!
  - Check design in BC-HCE/ProVal prior to sending to machine
- If the design is wrong the surface is wrong
  - If you are milling or paving, this is your last chance to get it right!



Undensified Corridor Surface
Curves and Vertical Curve surfaces are more segmented, not smooth



TRIMBLE BC-HCE CORRIDOR - OCT 2017 - Business Center - HCE
Plan View [My Filter]
Alto Ave
200 ft
Densified Corridor Surface
Curves and Vertical Curve surfaces are more uniform and SMOOTH
Plan View2 [My Filter]
100 ft
Surface Terrain Simulation Window [My Filter]
Station: 24+35.00
Location: 9402.290, 4865.439
Alignment elevation: 1999.764
Alignment grade: 0.23%
VE: 1.0
Station
24+35.00
Speed
Start
0.000
mph
Snap US Survey Foot Calibrated
9413.653 ft, 5166.838 ft

Key Ingredients for a Successful 3D AMG Project

- As-built or existing surface data accuracy should be equal or better than the technology being used
  - If the AMG technology can achieve 3mm to 5mm [0.01’ to 0.02’], as-built data accurate at 10mm to +20mm [0.03’ to +0.07’] is not ideal
  - The data can be used for a 3D design and/or to verify was has been milled or placed

Questions?

Notable/Award Winning Projects

- Telluride CO Airport Project with Kiewit
- New St-George UT Airport Project with Western Rock [Staker Parson/Oldcastle Group]
  - https://www.youtube.com/watch?v=35uxS4BE4ag
- Provo River Constructors [PRC] I-15 Project in Provo UT
- Port Mann-Hwy 1 Project in Vancouver BC with Kiewit
- Circuit Of The Americas [COTA] F1 Track in Austin TX with Austin Bridge & Road
  - https://www.youtube.com/watch?v=ygC-vbVv7oc
- Western Wake Expressway Raleigh NC with Lane
- Colorado Springs CO Peterson AFB Runway Project with Kiewit
- Honolulu HI Reef Runway Project with JAS W Glover
  - https://www.youtube.com/watch?v=DKKjUXrIQLU
- Bowling Green KY National Corvette Museum Motorsports Park [Corvette Test Track] with Scotty's Contracting
  - https://www.youtube.com/watch?v=napiTkJT2os
- Quebec Ministry of Transportation
- Bogota El Dorado International Airport
- US Bank Vikings Stadium in Minneapolis MN with Park Construction
  - https://www.youtube.com/watch?v=UUbKFCW2-NY
- Numerous FHWA/State DOT Intelligent Compaction Projects