Introductions
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- Brad Cunningham, SITECH Ohio
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- Steve Prosek, Kokosing Construction Co
  - Area Manager
What is covered in the presentation

▪ 3D AMG in Construction
▪ Overview of Concrete Paving Equipment
▪ 3D Concrete Stringless Paving
▪ The First Trimble ODOT Stringless Concrete Paving Project
  – Cleveland I-271 Project – Kokosing Construction Co
▪ Results
▪ Benefits
▪ What could possibly go wrong?
▪ Key ingredients for a successful Stringless Paving Project
What we will cover today

- 3D AMG in Construction
- Overview of Concrete Paving Equipment
- 3D Concrete Stringless Paving
- The First Trimble ODOT Stringless Concrete Paving Project
  - Cleveland I-271 Project – Kokosing Construction Co
- Results
- Benefits
- What could possibly go wrong?
- Key ingredients for a successful Stringless Paving Project
3D AMG in Construction
3D Automated Machine Guidance [AMG] In Construction

- References a method of placing and managing materials on a project
- Utilizes technology to guide a machine while referencing an engineering design
- Does **not reference anything on the ground for grade control**
- AMG is a term used with State DOT’s and the FHWA
- By technology standards, 3D AMG is a “seasoned” method in construction dating back to the 1990s!
  - It is a survivor... Remember PCMCIA Cards and Y2K?!?
3D AMG In Construction

- 3D AMG is a process [not just a product]
- Includes:
  - Survey Control Reference Points
  - 3D Design
  - 3D Technology
  - 3D Support Team
  - Training
  - Etc...
- It is an investment
- Requires a commitment to change
- There is no magic button!
3D AMG In Construction

- **3D AMG Technologies:**
  - Precise Real-Time [e.g.: RTK] Global Navigation Satellite System [GNSS]
    - 0.1’ [30mm] or better
    - Typically “Golf Ball” accuracy or better
    - Technology used on mass-ex, subgrades, etc...
    - Can be used on a concrete Placer/Spreader
  - Universal Total Stations [UTS]
    - 0.01’ [3mm]
    - Technology use for fine 3D Grading, 3D Milling, 3D Curb & Gutter and 3D Paving
3D AMG Examples

This one is from the 1990’s!
Why use 3D AMG In Construction?

- To build better pavement structures!!!
3D Concrete Stringless Paving
Stringless 3D Concrete Paving

- 3D AMG on a Concrete Paver
- Replaces string/wire line as a guidance method
- 3D Technology guides the machine similar to traditional wand sensors
  - 3D sensor data is sent to the on-board OEM display
  - The OEM display sends guidance commands to the legs
    - Left/Right; Up/Down
- Removes the process and costs of placing, setting, maintaining and removing string/wire, pins, etc...
Stringless 3D Concrete Paving
Kokosing’s Concrete Paving Equipment

- Texture/Cure Machine
- UTS Mainline Paver
- GNSS Placer/Spreader
Stringless 3D Concrete Paving
Stringless 3D Concrete Paving
Stringless 3D Concrete Paving

Dual UTS Targets provide accurate Horizontal and Elevation Guidance

Very accurate Inertial Measurement Unit [IMU]
Sensors mounted on each side of machine frame for slope, pitch and roll
Stringless 3D Concrete Paving

Example of a Corridor 3D Design

Edge of Pavement

HAL

VAL

STATIONING

Cross Section
Templates
Transitions/
Superelevations
Stringless 3D Concrete Paving

Accurate Surface is created from the Corridor Elements

- Steering Guided to Alignment

† Vertical Guidance to Surface †
Stringless 3D Concrete Paving
Stringless 3D Concrete Paving

- From this:

- To this:
Stringless 3D Concrete Paving

▪ From this:

▪ To this:
Stringless 3D Concrete Paving

▪ From this:

▪ To this:
The First Trimble ODOT Stringless Concrete Paving Project
Project: Cleveland I-271
- ~6 mile project pavement replacement and widening
- Between the Cuyahoga/Summit County line and Miles Road
- $119,988,186 ODOT Project [Federally and State funded]
- The existing lanes: full-depth pavement replacement
- I-271 widened to three lanes north and southbound
- Project includes widening of six existing bridges; the construction of two new structures; new lighting, signing, noise walls and concrete barriers
- Estimated Completion Date: June 2020
- Ref: http://www.dot.state.oh.us [08/01/2016]
Contractor: Kokosing Construction Co

- Westerville, OH [Corporate Office]
- Specializing in all facets of road and bridge construction
- Long time 3D AMG mass-ex/grading and 3D milling user
- First time with 3D Concrete
  - Implementation began in 2017
  - Various delays [e.g.: weather] pushed operation setup to June 2018
Setup Process & Preparations

- Kokosing consulted with SITECH Ohio to discuss 3D concrete paving options
- Process included consulting with Trimble Paving Specialist
- Tasks were assigned to Kokosing to review the project Survey Control and 3D Design
  - The placement and accuracy of the survey control is important
  - The corridor design must meet the project specifications including smoothness
- Kokosing took ownership and followed all instructions, suggestions and recommendations to ensure complete success!
Setup Process & Preparations

- Planning and preparations continued towards 3D technology installation and training
- Before any technology is ordered/installed, the machine has to be checked with the manufacturer to ensure it is certified for 3D AMG
  - There can be possible machine SoftWare and/or Display upgrades
  - Machine may require a 3D Prep Kit [OEM specific masts, brackets, etc..]
- Kokosing’s G&Z S850 Concrete Paver required SW upgrades and a 3D prep kit
Setup Process & Preparations

- SITECH Ohio ordered and installed the Trimble PCS900 3D Mainline Concrete Paver Solution technology on the machine.
- SITECH Ohio also supplied the supporting Trimble Site Positioning Solutions infrastructure:
  - Includes UTS’ for tracking machine
    - Requires 2 UTS for machine guidance and 2 for transitions or “leapfrogging” so the machine does not stop
  - UTS Rover for checking grade behind the machine
    - Double check to ensure machine is placing at correct elevation/grade
    - Adjustments can be made both Horizontally and/or Vertically on the machine.
Setup Process & Preparations

- Kokosing’s Construction Survey Team checked and verified the Survey Control points
- *.csv file [comma separated values]
  - POINT NUMBER, NORTHING, EASTING, ELEVATION, ID CODE
Setup Process & Preparations

- Survey Control Points in BC-HCE
Setup Process & Preparations

- Kokosing’s Data Management Team worked hard to ensure they had the perfect 3D design following the project’s specifications
  - The data must be built as a Corridor
  - It is very important the Corridor surface meets or exceeds the IRI [smoothness] specifications
Setup Process & Preparations

- Trimble BC-HCE Corridor – Referencing Project w Google Earth
Setup Process & Preparations

- Trimble BC-HCE Corridor
Setup Process & Preparations

- Trimble BC-HCE Corridor
Setup Process & Preparations

- Trimble BC-HCE Corridor – Smoothness Checks
Setup Process & Preparations

- Trimble BC-HCE Corridor – Smoothness Checks

Roughness Report

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Fixed Interval
## Setup Process & Preparations

### Trimble BC-HCE Corridor – Smoothness Checks

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Setup Process & Preparations

- Trimble BC-HCE Corridor – Surface Checks
Setup Process & Preparations

- Machine measure up
- Determines the dimensions between the two UTS targets and the bottom of the pan
- Typically measured on the inside of the overbuild
- Can be measured to the end of the overbuild as long as the pan is flat [not recommended]
- Machine [frame] must be completely level
  - Crossfall and Mainfall
  - Check pan to ensure it is level to frame!
Setup Process & Preparations

Measure-up Tools
Setup Process & Preparations

- Using the UTS, measure the points [UTS targets, measure-up tools]
- Trimble SCS900 [Data Collector] will compute the dimensions
- Results upload to machine display via USB
Setup Process & Preparations

- Team Training
- Understands roles, responsibilities and expectations
Results
Results

- Using Stringline: IRI = Mid-70’s
- Using Stringless 3D: IRI = Mid-60’s
  - This represents approximately 78,000 sy of 24’ wide paving.
3D AMG Benefits – Owner [e.g.: DOT/FHWA]

- Increase in safety on the job site
- Contractor maximizes production during construction
- Increase project delivery, reducing delays
- Construction is more accurate and cost effective
- Ability to catch possible errors and data inconsistencies in design before construction
- The ability to check Grade at any location on the project vs at specified cross section locations
3D AMG Benefits - Contractor

▪ Increase in safety on the job site
  – Tripping hazards, etc...

▪ Increased Production, more Efficient, less Rework
  – Fuel savings

▪ 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
  – Better machine management on and off the grade
What could possibly go wrong?
What could possibly go wrong?

▪ Not understanding the 3D process and continue to apply traditional methods
  – Unable to measure, calculate the value and cost savings for 3D AMG

▪ Unrealistic expectations
  – The “magic” button
  – All 3D designs are created for 3D AMG
  – All Survey Control points on a project are sound and fit for 3D AMG
  – Not taking ownership

▪ Setting unrealistic goals
  – Implementing 3D AMG for the first time on the first day of production
  – No prior training
What could possibly go wrong?

- Trying to combine “traditional” construction methods
- Only using 3D AMG for “finish” grading or paving
- Not applying 3D AMG to the complete construction process
  - Typical with Mill/Fill projects or “Pavement Preservation” projects
  - Who owns the milling equipment?
  - Paving Contractor? Sub Milling Company?
- The following is an example of combining “traditional” 2D milling with 3D paving:
Example of paving on a non-3D surface

- Mill and fill project
- Existing road surface milled at 2” thickness
- Contractor checked milled grade using UTS Rover
- Elevations did not match
  - Typical milled areas were not deep enough
- When the milling sub-contractor had to remove more material, they over cut on average over +2” so they did not have to mill a third time!
- Concrete spec thickness: 4” [0.33’]
Why use 3D AMG In Construction?

- To build better pavement structures!!!
Example of paving on a non-3D surface
Example of paving on a non-3D surface

Any guess what is happening here?
Example of paving on a non-3D surface

- As the milled surface goes up and down
- It is difficult to control the end gates
- On a one mile pour, there was +25% overrun!!!
Traditional 2D Milling & 3D Paving

IF IT DOESN'T WORK, DON'T TRY TO FORCE IT.

YOU CAN'T MAKE A SQUARE PEG FIT IN A ROUND HOLE.

THE TIME YOU WASTE TRYING TO FIGURE THAT OUT COULD BE SPENT FINDING A ROUND PEG.
Example of 3D paving on a 3D surface
Questions?
2018 Trimble Dimensions
User Conference

November 5–7
The Venetian / Sands Expo Center – Las Vegas

www.trimbledimensions.com