1. Flores Automation & Machine Control (FAMC) Introduction
2. History of Stringless Paving
3. What is 3D stringless paving?
4. Benefits of Using 3D Technology
5. What technology is currently in the market?
6. What infrastructure does a contractor need in place to implement stringless technology?
7. What needs to happen once the 3D technology is purchased and in place?
8. Workflow of Stringless Paving
Mission Statement — Flores Automation and Machine Control continuously leverages our knowledge and capabilities as one of the premier stringless distributors in the United States to become the most in-demand partner for 3D control systems for construction machinery in the ever-expanding market.
Flores Automation & Machine Control Intro...

- CEO Frank Flores started Flores Automation in 2007
  - Specialized in industrial/mobile automation contracts to OEMs
  - Built engineering and management staff of ~24 employees
- Started Guntert & Zimmerman relationship in 2010
  - Currently programming S400, S600, S850SL, S1500, PS1200, & MP550
  - OEM engineering and programming that compliment FAMC controls
  - Currently performing paving machine retrofits for FAMC
- Started Flores Automation & Machine Control in 2012
  - Current Leica paving dealer covering the United States
  - Full services of training, support and service on your jobsites!
  - Machine control modeling services
Presentation Outline

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Paving started with Leica on a project in 1996 with a stop and go machine. The first machine automation test with robots was on a Wirtgen Test site in Windhagen, Germany 1997.
In 1997, the German Railway Agency proposed a project to 10 contractors to show new methods of building high-speed rail.

The project required contractors to maintain the wireline through the 240 mile length of the project for the duration of the project. 5 contractors backed out.

In 1998 A section from Berlin to Hannover was paved.

QC was completed soon after paving operations and the first stringless project was conducted from Köln-Frankfurt on a ICE high speed-rail 120 Miles long, with complex high-speed rail geometry, up to 11% cross-slope.
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What is 3D Stringless Paving?

The technology of monitoring your paving machine’s position with surveying instruments, and comparing to a digital model to control the movements of steering and elevation.
What is 3D Stringless Paving?

When a contractor goes “stringless” it means:

- They no longer have to setup wirelines to guide the machines.
- They must have Survey Control Point Information.
- They must have a specifically prepared “MODEL”.

[Diagram showing 3D modeling and survey data with numbers and coordinates.]
What is 3D Stringless Paving?...

Working with Stringline...

- Inspect design – calculate setting-out lists for each lane
- Setup a total station, survey each hub or pin position with total station (or GPS if accuracy isn’t important!)
- Hammer (or drill) in each pin, minimum 1 line for each lane of concrete/asphalt
- Check pin alignment & adjust if necessary
- Survey and set stringline height on each pin (min. 2 men)
- Install & tension clamps and stringlines
- “Eyeball” & adjust stringlines before paving
- Move machine into position, set sensors to stringline
- Check machine position relative to stringlines
- Start Production, monitor machine position
- Ensure (or hope!) nothing disturbs or damages stringlines during paving/milling...

Reference Point

Walk left 5 ft!
Walk right 1 ft!
Up a bit!
Down a bit!
STOP!
What is 3D Stringless Paving?...

Working with 3D...

Before project starts...
- Convert design to 3D model
- Load onto 3D computer
- Throw away the stringlines!

On paving days only...
- Setup Total Stations (15 mins)
- Start Paving
- Move Total Stations as range is reached (“leapfrogging”)
What is 3D Stringless Paving?...

3D = Smoother, design-conforming Pavements
Stringline = approximation

True Vertical Curves $\rightarrow$ Improved Thickness/Smoothness, no "pin bumps"

Levelling, "Eyeballing" & Tensioning adds error

Horizontal Curve
"Chording" $\rightarrow$ Wastes
Concrete
What is 3D Stringless Paving?

Typical Concrete Paving Setup

Reference Point

3D Computer & Radios

3D Slope Sensors

Robot #1 (Guidance)

Robot #2 (Guidance)

Robot #3 (As-builts & Leapfrog)

Reference Point
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Benefits of Using 3D Technology

Safety

Site Hazards

- Walking hazard eliminated for workers near stringline
- Vehicle hazard eliminated for driving near stringline
- Helps eliminate personnel injury due to repetitive swinging of a hammer.
Benefits of Using 3D Technology...

Cost Savings

Removes wire lines and conventional survey pins from the jobsite

- Eliminates the drilling, pounding, & surveying in pins to base the wire elevation
- Eliminates material costs and transport for posts, wire arms, and wire
- Eliminates “bumps” to the wire during operation
- The robotic instruments included give the ability to check and verify alignment and elevation before and after paving or milling for exact quality control

The stringline is virtually created, and put right on the machine computer

- No waiting for surveying before production
- Can help eliminate over run on paving projects or over milling
- Can increase productivity, quality and performance bonuses
Benefits of Using 3D Technology...

Logistical Advantages

Roadway is now open
- Trucks no longer need to back up so far
- No “Gates” in wireline needed
- Better versatility moving through site
- Can create the opportunity to combine “phases” on certain projects.

Wireline Clearance
- Track grade is now the width of the actual machine
Benefits of Using 3D Technology...

Who is taking advantage of these benefits?

- ACME – Spokane, Wa
- Acura Inc. – Bensenville, IL
- Anthony Allega – Valley View, OH
- Archer Western – Fort Lauderdale, FL
- Atlantic Contracting – Chantilly, VA
- Baseline Contracting – Copley, PA
- Boh Brothers – New Orleans, LA
- Cemex – Mexico
- Concrete Placing Company – Boise, ID
- D&J Enterprises, Inc. – Auburn, AL
- Emery Sapp – Springfield, IL
- ET Simonds – Carbondale, IL
- Flynn Company – Dubuque, IA
- Fred Weber – Maryland Heights, MO
- Golden Triangle – Imperial, PA
- Hawkins Construction – Omaha, NE
- Interstate Highway Contractors – Englewood, CO
- Integrated Concrete Construction – Hayward, CA
- K-Five – Chicago, IL
- Knife River Midwest – Sioux, IA
- KOSS Construction – Pauline, KS
- MarCor Construction – Nashville, TN
- McCarthy Improvement – Davenport, IA
- OHL – Santa Ana, CA
- Prince Contracting – Tampa, FL
- Superior Const. – Jacksonville, FL
- Southwest Concrete Paving – Phoenix, AZ
- Toebbe Construction – Wixom, MI
- Trierweiler Construction – Marshfield, WI
- WK Construction – Waterloo, IA
- Walsh Group – Chicago, IL

Many more….
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What technology is currently in the market?
What technology is currently in the market?...

Direct Paving Dealers
Same support personnel for all paving applications in North America
Manufacturer support for FAMC

Local Machine Control Dealer Network (Sitech)
Manufacturer support for the Sitech dealer

Local Machine Control Dealer Network
Manufacturer support for the dealer
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Contractor Infrastructure Requirements

Open-minded Crew Willing to Change

• Market as a whole is still new and changing often.

• Software/Hardware updates are provided frequently.

• Many procedures in the field are new until learning curve is complete.
Survey / Grade Checker Resources

- Many layout abilities are possible with the instruments.
- Any surveying experience is a benefit, but not necessary.
- Accurate checks and adjustments need to be communicated to ground man.
- Bridging the gap between data prep and field work benefits the crew as a whole, it is good for the Surveyor/Grade Checker to have this experience to help the communication between office and field.
Contractor Infrastructure Requirements...

Ground-man, Adjustments to the Machine

- One person will usually monitor the corrections needed to keep quality of the paving
- This will usually be someone with paving experience who knows what to look for
- Good communication on what needs to be adjusted within the pave crew is ideal
**Data Preparation Resource**

- The model now becomes as important to the spread as the wire was.
- The quality of these models is dependent on success of paving accurately.
- Without this in-house ability, it is highly recommended to use a professional service to provide accountability.
- Good support within the software products you use is crucial.
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Steps After Purchase

Defining Roles

- Total Station - setups and care of equipment
- Groundman - for adjustments to machine
- Data Prep - resource in house or contracted
- QC and Staking - Grade Checking, Layout, and Topo
Steps After Purchase...

Proper Training

- Thorough understanding of operation and troubleshooting instruments
- Proper understanding of maintenance of instruments (calibrations)
- Initial training away from production
- Follow through training while in production
- Understanding of how to measure and report production
Steps After Purchase…

Reasonable Expectations of Crew Workload

• Understand what your investment leaves you capable to handle
• One mainline system will not always be feasible to move between sites
• Production rates of stringless need to be established by how well the crew has accomplished the learning curve of the new workflow
• Management of the survey, modeling, and capable crew members must be taken into account
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Workflow of Stringless Paving

Request and Verify Survey Control

Site Control Points...
Machine Control is only as good as the control!

With this information, we can setup total stations anywhere we want based on the survey information provided.
Workflow of Stringless Paving...

Build Model – Line-work Models

- CAD based format of elevated lines
- All lines are selectable for reference to that line’s position and elevation
- All alignments are tangent based
- Based on Northing, Easting, Elevation
Workflow of Stringless Paving...

Build Model – Line-work Model Example #1
Workflow of Stringless Paving...

Build Model – Line-work Model Example #2
Workflow of Stringless Paving...

Build Model – 3D Surface Models

- Full site coverage using Triangulation between known elevations
- Usually not “seen” by the operator, but calculates corrections anywhere on the site in the background of your software
- Used in combination with a 3D Line-work File for visibility
- Based on Northing, Easting, Elevation
Workflow of Stringless Paving...

Build Model – Surface Model Example #1
Workflow of Stringless Paving...

Build Model – Surface Model Example #2
Workflow of Stringless Paving...

Build Model – How are models built?

- There are various design packages available in the marketplace today. Below are just a few of them.
- These packages are for design engineers at Engineering houses or DOT’s, and are the formats we can receive to start the modeling process.
Workflow of Stringless Paving...

Build Model – How are models built?

- Leica iCON Office
Workflow of Stringless Paving…

Build Model – How are models built?

• Trimble Options
  - Trimble Terramodel
  - Trimble Business Center
Workflow of Stringless Paving...

Build Model – How are models built?

- These packages export generic formats that the manufacturer software can recognize.

  Linework = .DXF      Surface= .XML      Alignment Models= .XML

[Logos of Autodesk, AGTEK, Carlson, 12d Model]
Workflow of Stringless Paving...

Build Model – Is your model SMOOTH?

- Convert an edge of paving to a TXT file of points, then import to PROVAL.

- Simulate ride scores on your smoothness specification.

- Check for frequencies of breaks in your profile.

- Once you know the ride score of your data, you can adjust what to expect from your AMES or SSI scores.
Workflow of Stringless Paving...

Build Model – Is your model SMOOTH?

- Ability to predict ride quality, with all external factors being equal.
Workflow of Stringless Paving...

Build Model – Is your model SMOOTH?

- Industry standard outputs! If the theoretical IRI looks good, we are ready to load it on the machine.
Workflow of Stringless Paving...

Setup Total Stations

Backsight Setup on a Control Point

\[ XYZ = ? \]

\[ XYZ \checkmark \pm ? \text{mm} \]
Workflow of Stringless Paving...

Machine Calibration

- A machine measure-up is required when anything is physically moved on the machine. For example, width changes, mast height adjustments, etc.
Workflow of Stringless Paving...

Dry Runs

- After model for production is loaded, dry run the machine to tune steering, elevation and ensuring model is correct. This ensures an added level of insurance as to a step being skipped or not done correctly.
Workflow of Stringless Paving...

Validate Total Station Hopping Patterns

- Dry runs are a good time to envision total station layouts.
- Depending on truck routes, line-of-site objects (trees, signs, etc.) different jobs have limited options and distances between total stations.
Workflow of Stringless Paving…

Ready to Pave!

• Your model is telling your machine where to go and at what elevation to pave, pour or mill to.
• If you are concrete paving, it is very important that your finishers are not “over-finishing” the concrete.
• Your grade checker is checking grade behind you and monitoring the information on your screen.
Web References

Positioning Manufactures:
- www.leica-geosystems.com
- www.trimble.com
- www.topconpositioning.com

Software Manufacturers:
- www.autodesk.com
- www.carlsonsw.com
- www.agtek.com
- www.12d.com
- www.bentley.com
- www.vianovasystems.com/Products/NovapointDCM
- www.liscad.com

Machine Control Market Website:
- www.machinecontrolonline.com
Thank you for your attention!

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