Automated Machine Guidance

An Overview

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4 May, 2016

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Maps

- Purpose - Visualize a representation of a (physical) real world area
- Evolution
  - Crude sketches (2D)
  - 1:x Scale drawings (2D)
  - 1:1 Scale drawings (2D and 2 ½D)
  - True 3D (varying levels)
- Virtual world

Design Workflow - PAST

- Referenced to alignment (“P” line, etc.)
- Site represented by 2D Base Map
- Terrain represented by Cross Sections
- Grade represented by Profiles
- Blind between data points
- 2D design
- Paper plans and specifications
- Wet signatures

Design Workflow - TODAY

- Geospatially referenced
- Coordinates projected to plane
- Site represented by 2 ½ D Base Map
- Terrain represented by Digital Terrain Model (DTM)
- Blind between data points – albeit closer
- 3D roadway prism design flattened to 2D
- Paper plans and specifications
- Wet or Digital signatures

Design Workflow - FUTURE

- Geospatially referenced
- 3D coordinate system – No projections
- Site/Terrain represented by virtual world
- Full 3D design
- Digital signatures
- 3D data utilized for construction
- Hierarchy – Data primary, plans secondary

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Machine Guidance

A **Machine Guidance** system uses automation to provide the equipment operator a **visual indicator** of the position of the cutting edge (blade, bucket, screed, etc.) relative to the design surface being constructed.

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Machine Control

A **Machine Control** system positions the cutting edge of the equipment through automation.

The system is connected to and controls the hydraulics while the operator simply drives the equipment and manages the automation.

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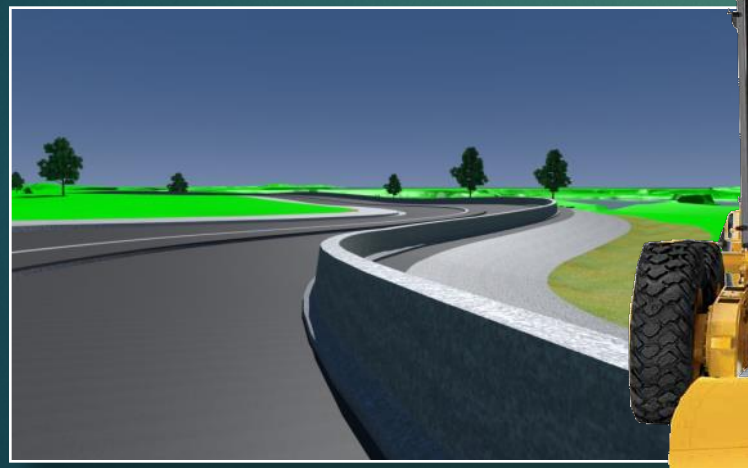
3 Components of Machine Control

1. The design and resulting data
2. The machine w/computer, sensors, hydraulic controls, and data communication
3. The positioning system – GPS, TPS, laser, or combination



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Machine Control

The ultimate system:

- No stakes required
- No grade checker required
- Records data for quality control
- Records data for volume computation
- Data could be transmitted to engineer, inspector, or surveyor for “real time” checks

Benefits (short list)

- **Contractor**
  - Less Bid Risk
  - Reduced Material Handling
  - Less Error
  - Increased Profit
- **Oregon DOT**
  - Reduced Construction Costs (~ 6% FHWA estimate)
  - Conveys Design Intent Better
  - Better Quality (increased life expectancy)
  - Reduced Construction time (~30% FHWA estimate)
  - Increased Safety (workers and motorists)
  - Better Material Quantity Management

ODOT's Approach into AMG

- 3D Pre-Design Survey
- 3D Design
- Digital Bid Packet
- Pre-Construction Survey
- 3D Model Provided to Contractor
- Tools for Inspectors
- Post Construction Surveys (future)
- Integration with 3D Virtual Transportation Corridor, Asset Management, and GIS (future)

GNSS Base Station

Part of the Oregon Real-Time GPS Network

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GPS Guided Bull Dozer

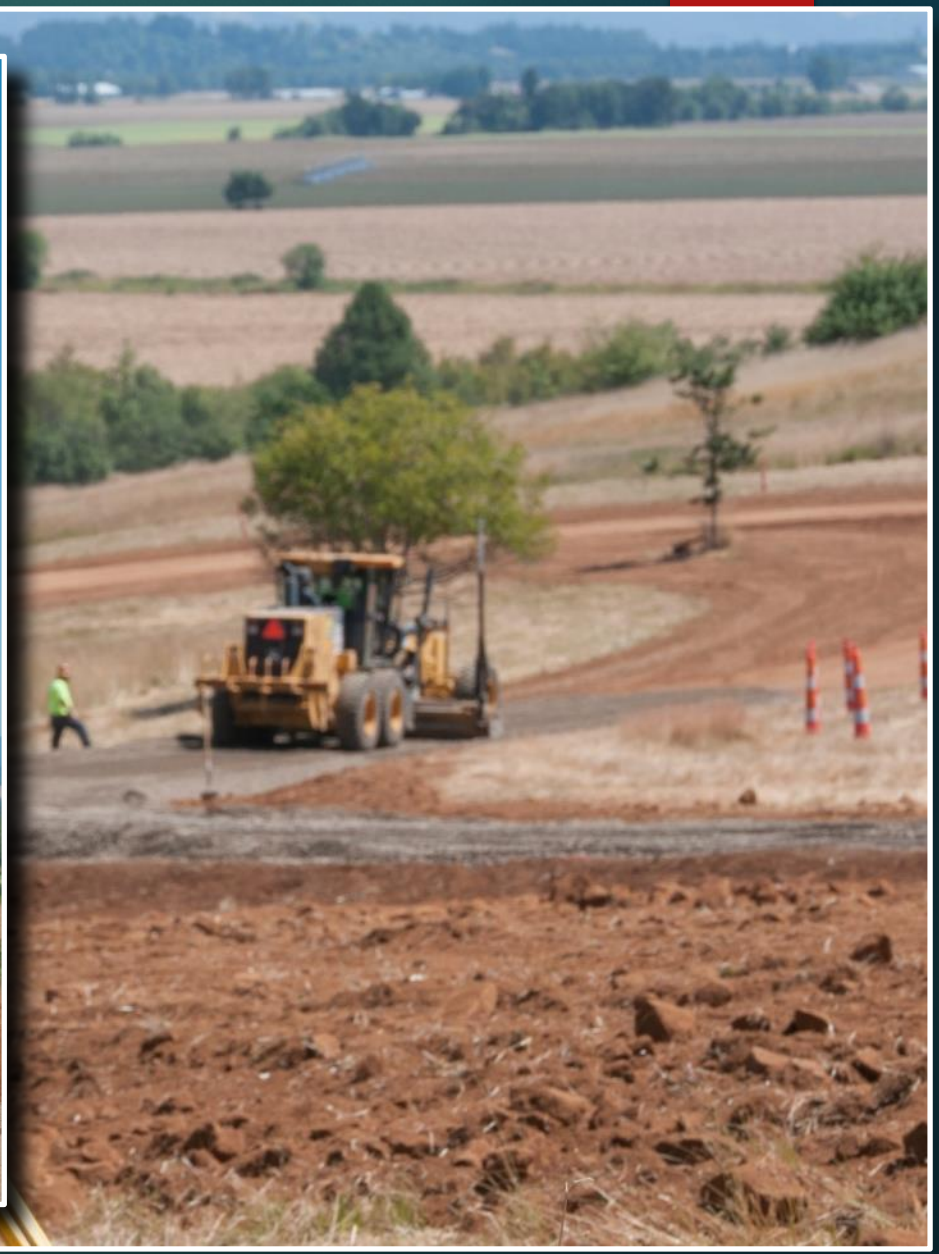
GPS Guided Excavator

GPS Guided Motor Grader

GPS Guided Motor Grader

3D Laser Scanner – Post Construction Survey

Robotic Total Station



Intelligent Compactor

Intelligent Compactor

Robot Controlled Curb/Wall Machine

Robot Controlled Curb/Wall Machine

Robot Guided Paver

Robot Guided Paver

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