



Inspecting Without Hubs



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Engineering Technology Advancement Unit
Oregon Department of Transportation

ODOT Engineering Automation Conference

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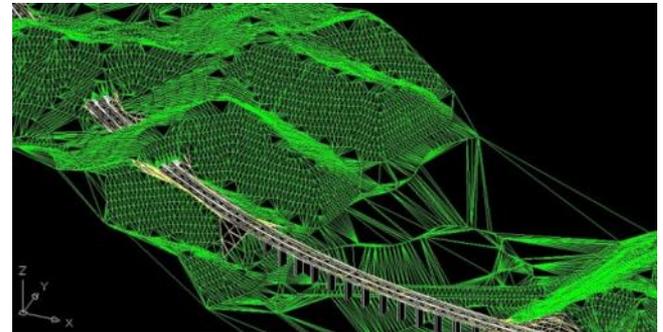
New ETA team member

- Jorge Jimenez, PE
 - Construction Automation Inspector
 - Started Monday!
 - Will be working on:
 - All things Inspection
 - AMG
 - Construction Technology
 - TBD?



Paradigm shift: Paper to Digital

- The paper plans are becoming less and less “useful” for showing design intent
- The digital model has all of the details and is becoming the final design product





Paradigm shift: Stakes to AMG

- Lots of stakes to very few stakes



Biggs Jct Interchange – US97 Slope Cut



How do I keep up?

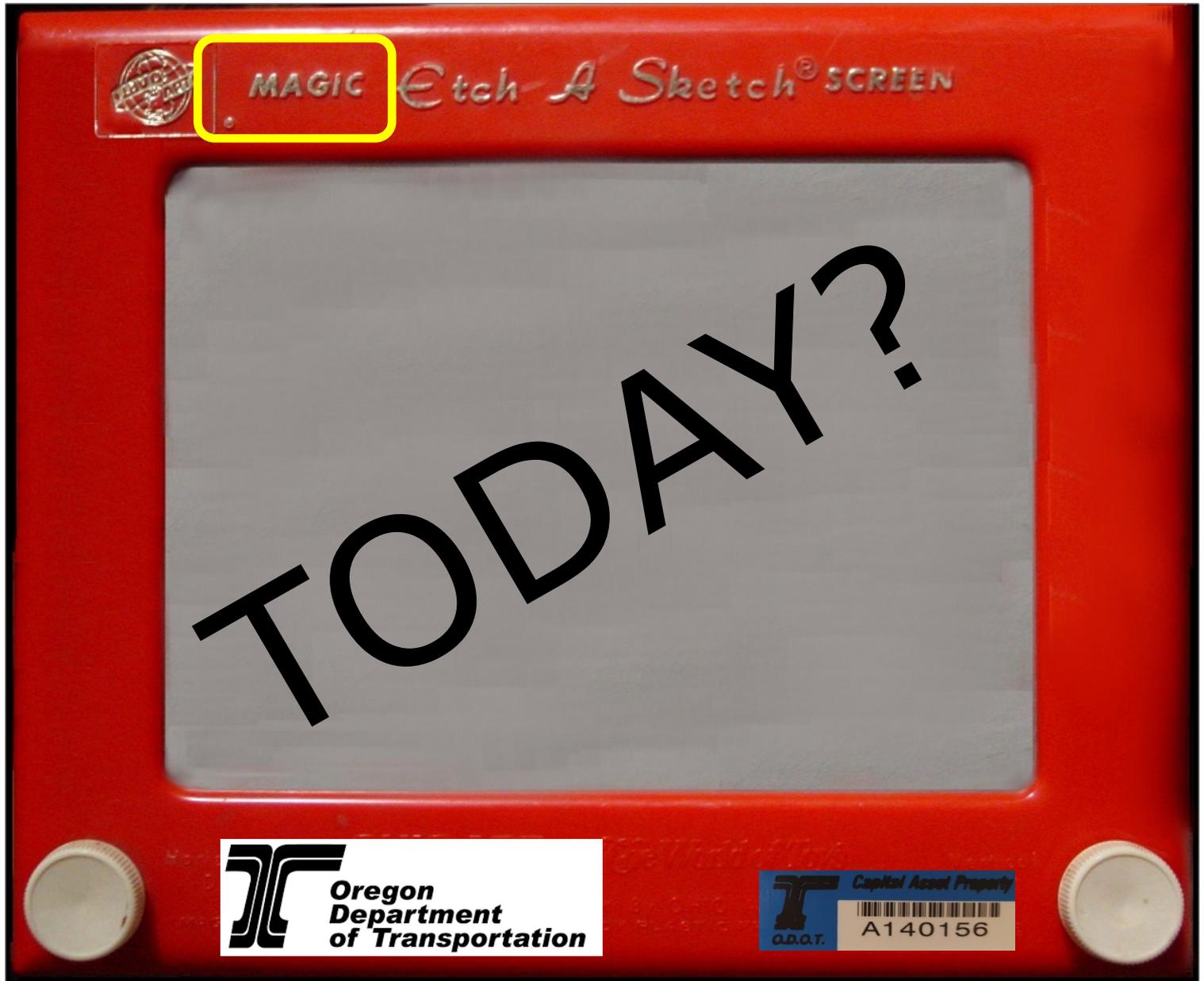
- Need to be able to do your job
- Need the same data the contractors have
- Need to be able to determine line and grade
- Need to know when to call a surveyor
- Need the right tools
- Need the right training





In the Future we might have...

- Surface Pro Tablet for paperless documentation (e-Construction)
- Open Roads Navigator for viewing design/plans (Bentley Mobile Product)
- 3D Visualization tools (Above & below ground)
- eTickets for material delivery
- Connected site with ability to monitor equipment/results
- Automated Daily Report to tie it all together



MAGIC

Etch-A-Sketch® SCREEN

TODAY?


Oregon
Department
of Transportation

 Capital Asset Property
A140156



Real Solution Available Today

- Inspector Positioning Tablet





Pilot project

- 15 tablets deployed
- 8 PM offices
- +/-60 Construction staff trained
- Possibly more on the way
 - FHWA AID grant
 - Cross your fingers!
 - More tablets
 - More training

Accelerated Innovation
Deployment (AID) Demonstration



The Tablet

- Rugged Tablet with built in GNSS antenna +/- 2cm accuracy
- Can be used "handheld" or with an external antenna and rod



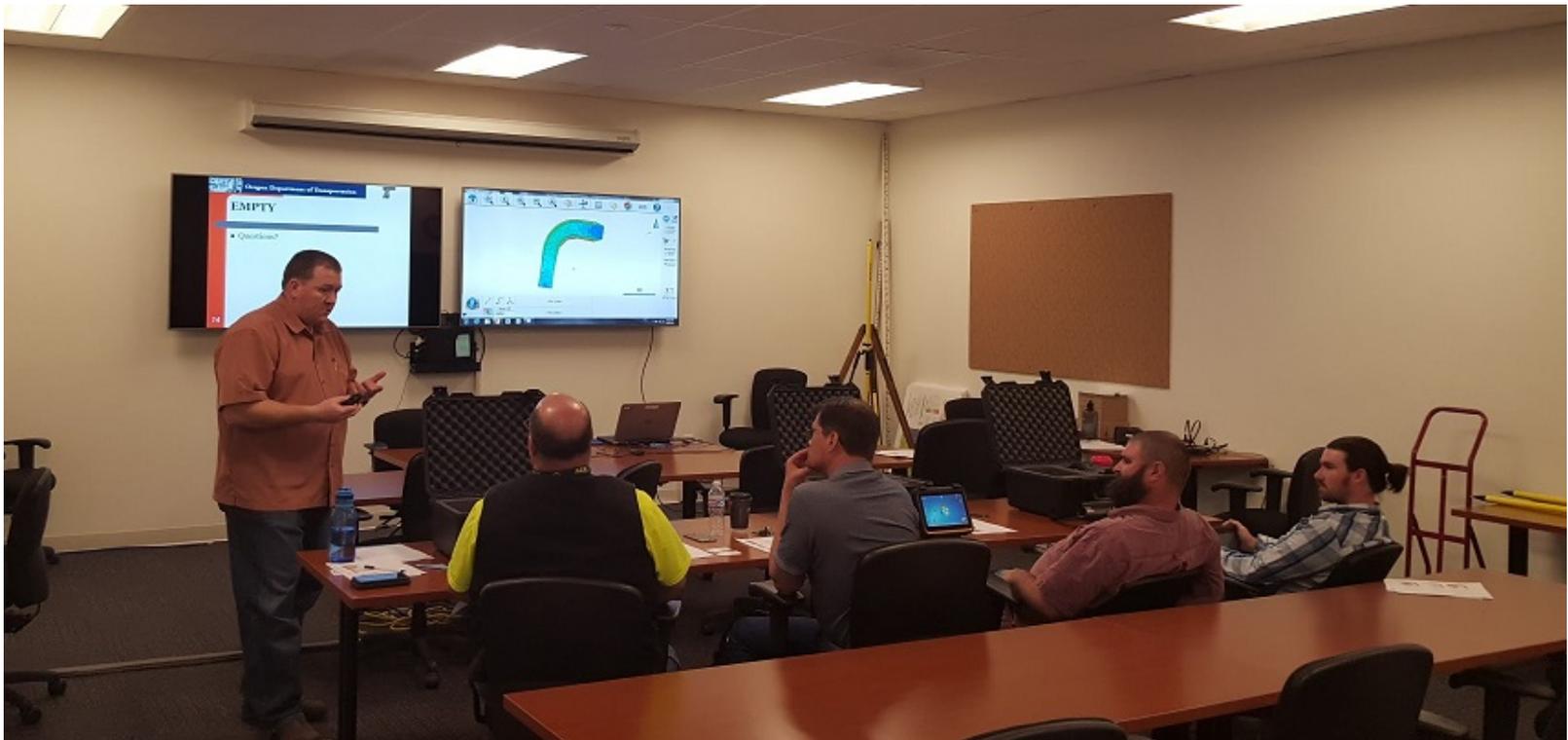
- Software to display and use XML files for alignment, surface and design files





Delivered with Training

- Classroom and field training required





Survey Grade Accuracy

- In handheld mode it is only as accurate as you can 'hold' it (+/- 0.20')
- Attached to a rod with an external antenna it is a survey grade GNSS unit (+/- 0.07')





Provides fully independent check

- Not connected to contractors' system
- Works on same coordinate system as surveyors and designers
- Inspector can determine line and grade anywhere* on a project
- Collect data for quantities, locations, and as-constructed data

*Where GPS and Cellular data coverage allow

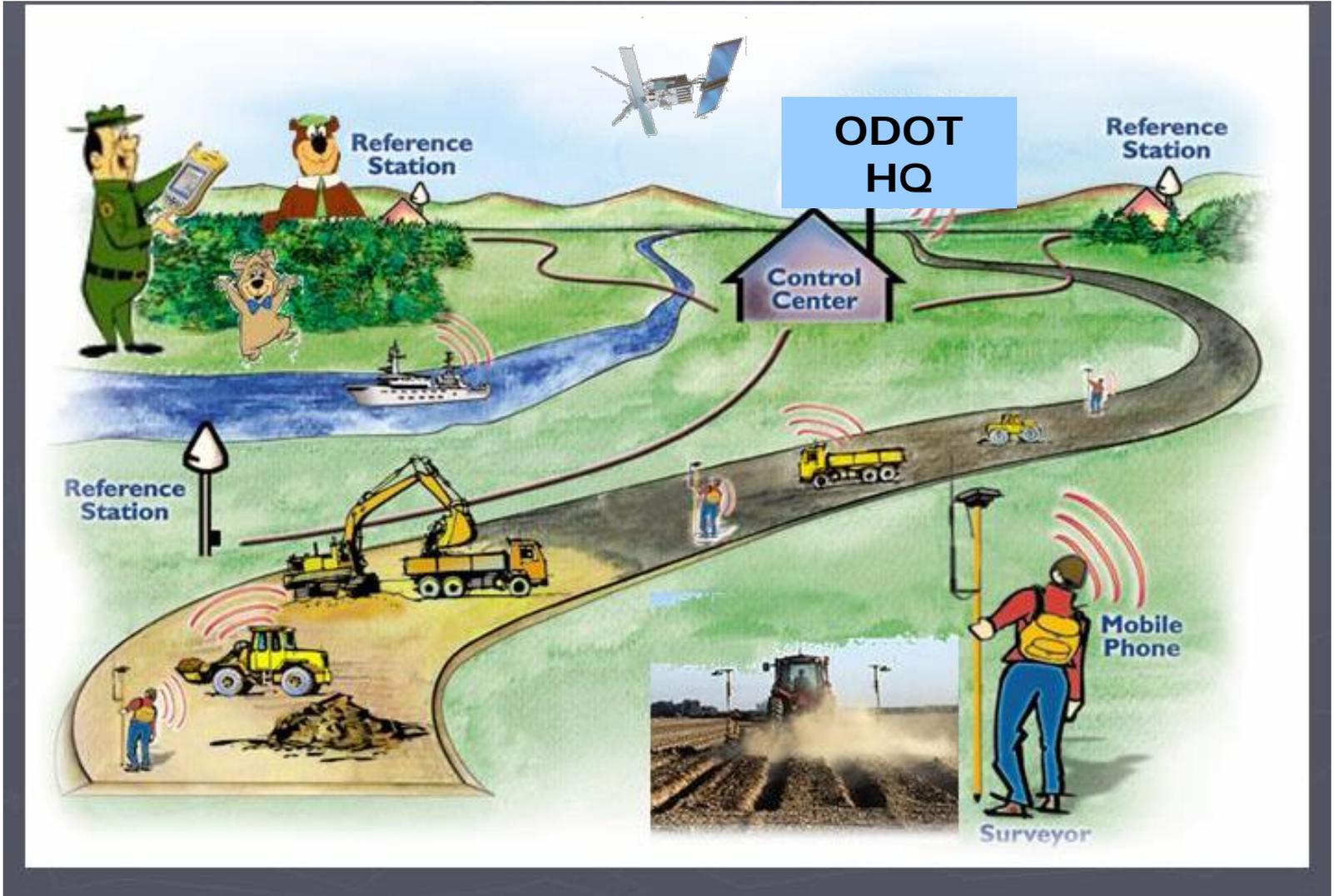


How does it Work?

- Hardware receives GNSS satellite signals
- Software receives an RTK corrector from the Oregon Real Time GNSS Network (ORGN) using cell data
- The result: Survey Grade Positioning



The ORGN in Action





Starting FieldGenius on the Tablet

Opening
FieldGenius
from the
Desktop



Data Collection and Documentation

The screenshot displays the FieldGenius software interface for data collection. The main window shows a map with several points labeled 500, 501, 502, and 503. A red arrow points to point 500 with the text "You are Here!". A blue line on the map is labeled "300'". The status bar at the bottom shows "Next ID" as "Y1" and "<No Desc>". The "RTK Fixed" status is highlighted with a red circle.

Toolbar icons include: Download, Zoom In, Zoom Out, Pan, Rotate, Undo, Redo, Grid, Layers, Settings, and Help.

Right-side panel shows: North arrow, Scale (0.09', 0.19'), Antenna (3.50'), Standard Measure, and RTK Fixed (circled in red).

Status bar: Next ID: Y1, <No Desc>



Data Collection and Documentation

FieldGenius

Store Point

Point ID: 10002

Description: HYD List

Northing: 205528.7459'

Easting: 185278.7642'

Elevation: 216.5469'

Antenna Hgt: 3.5000'

Store As: GNSS Point

Review Measurement

GIS Attributes

Advanced

Enter Note

Store Pnt Cancel



Data Collection and Documentation





Starting a Job and Capturing a Point

Connecting to
the GPS and
ORGN and
Collecting a
Location



Line and Offset

- Can handle multiple alignments
 - With multiple vertical profiles
- Pick the alignment you want
 - Tap with your finger
- Station and Offset as you move
 - Displayed on the main page
- Can stake specific station/offset points



Line and Offset

TLC-1 - FieldGenius

Stn	20+00.07
Offset	L 0.27'
Cut to	0.35'

PAN

20+00.00 C 0.00'

Staking Method: Stationing - Absolute

PDOP 1.9

6

Antenna 3.50'

RTK Fixed



Line and Offset

TLC TEST - FieldGenius

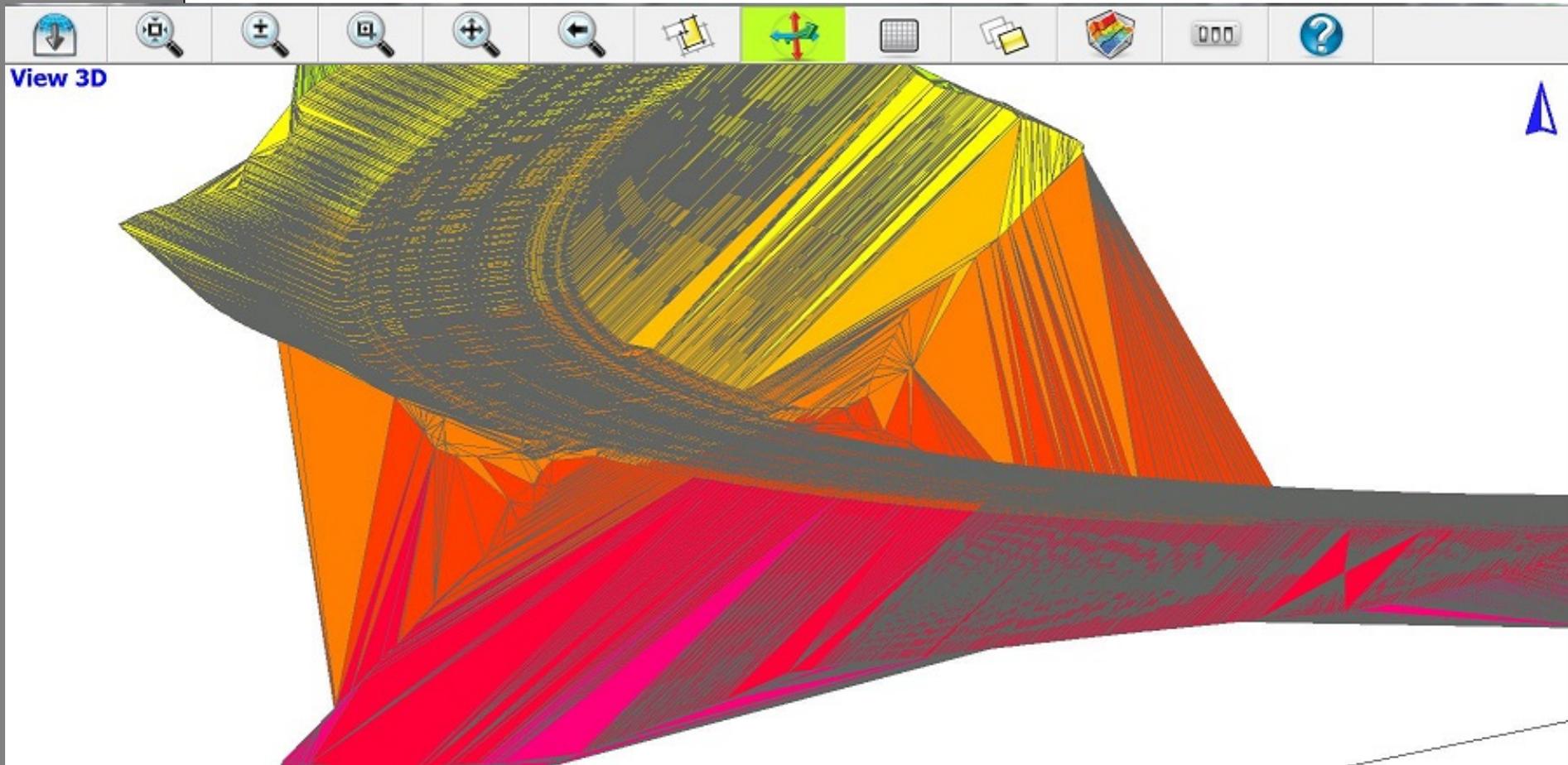
Station **20+38.7255**
Offset **-7.8773'**
Cut/Fill

PDOP 1.4
7
Antenna 3.5000'
Standard Measure
RTK Fixed

<No Line>
Next ID 10014
<No Desc>



Surfaces





Checking a Surface

The screenshot shows the FieldGenius software interface. The main window displays a curved line with several points labeled with IDs: 10001 (SSM/H), 10003, 10006, 10004, 10005, 10008, 10000 (TEST), and 500 (PK). A blue triangle marker is labeled 10010. A blue scale bar at the bottom right indicates 50 feet. The software title bar reads 'TLC TEST - FieldGenius'. The top toolbar contains various navigation and editing tools. The right sidebar shows a blue arrow icon, a green crosshair icon, and a wrench icon. The bottom status bar shows the time as 9:49 AM on 4/25/2016.

0.0295'
0.0525'
9
Antenna 3.5000'
Standard Measure
RTK Fixed



Design files/line work

IS SISKIYOU REST AREA - FieldGenius

The screenshot displays the FieldGenius software interface. At the top, the title bar reads "IS SISKIYOU REST AREA - FieldGenius". Below the title bar is a toolbar with various icons for navigation and editing. The main workspace shows a design plan with a storm inlet (a circle with a cross) labeled "10009". A line connects the inlet to a rectangular structure with vertices labeled "10010", "10011", "10012", and "10013". A blue dimension line indicates a distance of "30'" between two points. A blue north arrow is located in the top right corner. The bottom toolbar contains icons for file operations, drawing tools, and a red 'X' button.

Line on DXF Layer:P_HY_STORM_InletCenter

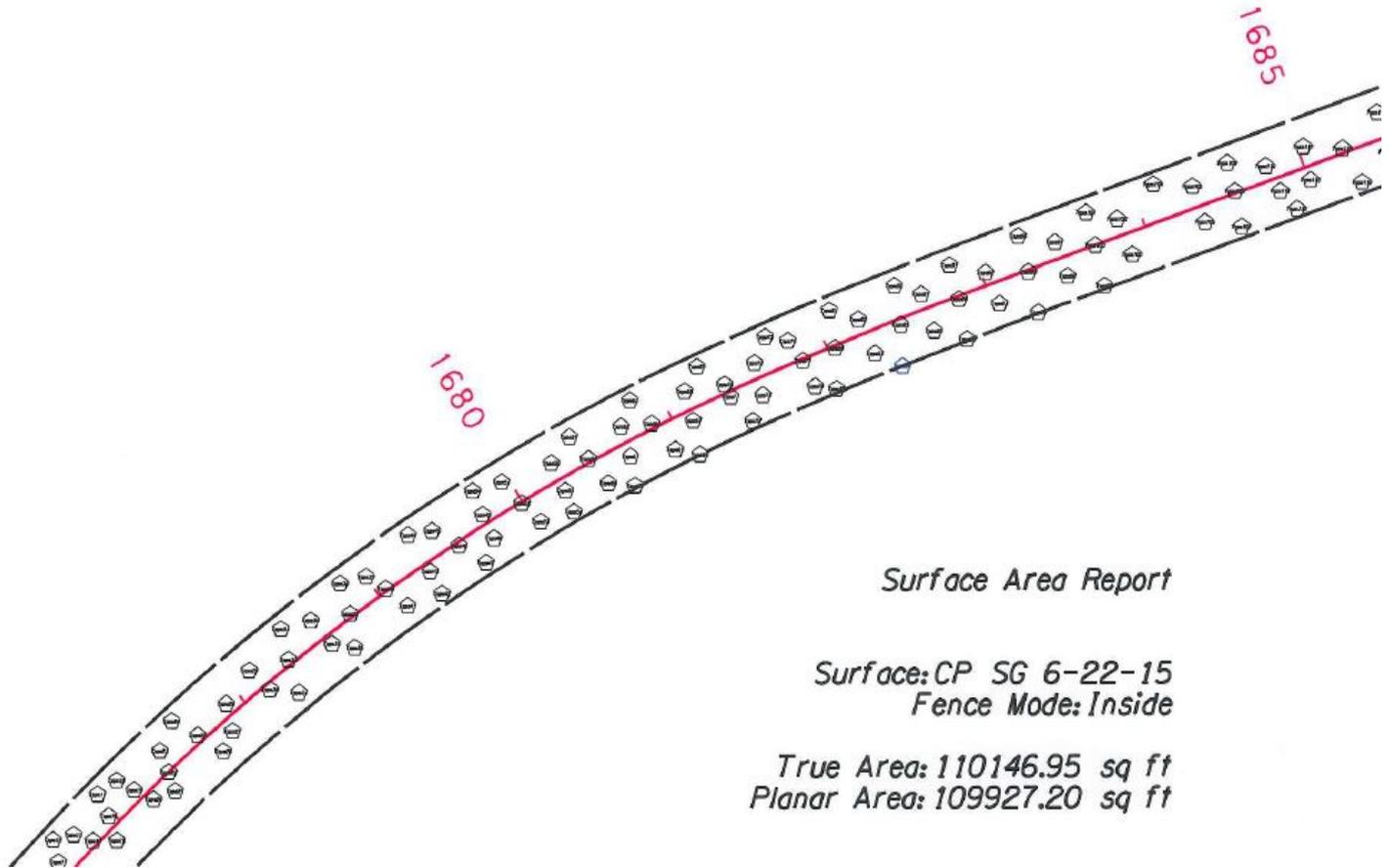


How else can I be sure the machines are 'correct'?

- Grade Verification Points
 - New name for Construction Confidence Points
 - Survey points collected to provide a reasonable record of the grade as constructed
 - Used to verify that a constructed grade has been built according to the line and grade of the design



Grade Verification





Grade Verification Points

- Committee working on a new chapter for the Construction Survey Manual for Contractors (SP00305)
 - Contract Administration
 - Specifications
 - Construction/PM Offices
 - Engineering Automation



Grade Verification Points

- Provide guidance to the process
- Consistency
 - For PM Office
 - For Contractor
 - For Contract Admin
- Ensure ODOT is getting what we want





Grade Verification Points

Construction Survey Manual for Contractors

Chapter 5 – LINE AND GRADE VERIFICATION

5.1 General

Grade Verification points are to be collected such that they provide a permanent record of the existing ground surface and the proposed grade to be constructed. Provide grade verification points in the approved construction plan. The Engineer may request additional grade verification points if the contractor's placement does not meet the stated criteria in this chapter.

Grade verification points are to be collected before the placement of material, do not begin placement of the next course of material until the grade and approval is given to proceed.

Grade verification points are to be collected at the same points nor do they utilize the construction staking tolerance.

5.2 Accuracy

Contractors with surveying equipment that meets the tolerances of the work that is being constructed, the Engineer may require validation of the accuracy of the selected collection points.

If hub and stake are used to control the grade for construction, grade verification points shall be taken no closer than 5 feet from any grade control hub/stake.

The Engineer may require additional grade verification points as needed.

REVISÉ
Special Provision 00305 – "Contractor Surveying"
Construction Survey Manual for Contractors



Other 'Survey' options

- Require some contractor staking
 - PM has authority to require supplemental staking when AMG is used
- Walk the job with the contractors surveyor
 - Look over their shoulder
 - Direct them where to take shots
- Request assistance from an ODOT surveyor
 - Additional measurements
 - Additional verification points



What to watch for with AMG

- Is the 'right' positioning equipment being used?
 - GPS for +/- 0.06' (3/4")
 - TPS or hybrid system for under 0.04' (1/2")
- Proper setup and procedure?
 - Survey equipment setup properly
 - Machines calibrated to benchmark
 - Adjusting for machine blade wear
 - Grade check following machines





What to can go wrong with AMG?

- GNSS Setup error/localization error
- Machine setup/calibration error
- Machine blade wear
- Wrong files/versioning errors
- Operator error
- Poor location for GNSS use
- Bad luck!



Traditional Inspection Skills

- Watch the contractor
 - If it doesn't look right...
- Build relationships
 - As valuable as ever
- Ask questions
 - Don't assume anything
- Document the work
 - Put it on paper (or better yet digital)

Thank You!



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