ODOT’s Integrated Approach

- Mobile LiDAR Survey
- 3D Design & ProjectWise
- e-Construction
- Inspector Positioning Tools
- Automated Machine Guidance
- Future Concepts

Engineering & Construction Technology

Hyperlink to ODOT ETA Section
# OREGON DEPARTMENT OF TRANSPORTATION

## Traffic-Roadway Section

### SUBJECT
3D Roadway Design

### FINAL NUMBER
RD 13 - 03(B)

### EFFECTIVE DATE
12/31/2013

### VALIDATION DATE
12/18/2015

### SUPERSEDES or RESCINDS

### WEB LINK(S)
http://www.oregon.gov/ODOT/HWY/TECHSERV/Pages/technicalguidance.aspx

### TOPIC/PROGRAM
Highway Design Manual

### APPROVED SIGNATURE
Original signed by:
Bob Pappe, P.E., PLS
State Traffic/Roadway Engineer

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**PURPOSE**

To provide clarification concerning the required content, process/workflows, delivery timelines, and quality control of digital 3D Roadway Design data for Oregon’s Statewide Transportation Improvement Program (STIP) projects.

[Highway Design Manual Hyperlink]
Digital Engineer Seals

Adopted by Oregon’s Professional Engineer Board in 2008
## Project Detail: 15159 (OR569: BELTLINE @ DELTA HIGHWAY INTERCHANGE SEC.)

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Types of Lidar

- Static
- Mobile
  - Terrestrial
    - Land
    - Water
- Airborne
  - Fixed Wing (high altitude)
  - Helicopter (low altitude)
  - Unmanned Aircraft
Mobile Scanning & Survey - @ 55mph

ODOT scanned roadway generated as a 3-D point cloud with ¼ - inch tolerances

Return on Investment (ROI*) net benefit of over $1 million per year

*OSU report February 2017
Measure vertical clearance
Scaffold Failure Investigation

Vehicle for scale
Mobile Scanner’s Reach

What the operator sees, we can capture
3D Design & ProjectWise

3D design & plan set created from mobile mapping and fill-in survey

ProjectWise for central storage & collaboration

ROI* exceeds $1,500,000 net savings per year, expected to grow with wider usage

*OSU report February 2017
Oregon DOT Specs for 3D Contractors

• Specifications around AMG and 3D Models
  Definitions
  Order of Precedence
  Tolerances
  3D Model review
• Survey requirements for AMG work
  Grade Verification by contractor & DOT
• New tools for DOT inspectors
• Training for DOT inspectors

All the ‘new’ specs became effective April 1st, 2017

Oregon 2018 STANDARD SPECIFICATIONS
3D Model Review – Special Provision 00305

00305.00 Scope - Provide construction survey work according to the current edition on the date of Advertisement, of the ODOT "Construction Surveying Manual for Contractors". This manual is available on the web at:


In addition to the requirements of the ODOT "Construction Surveying Manual for Contractors", establish Engineering Stationing at (___foot) intervals for the length of the project along the shoulder of the highway. Maintain the stationing so it is visible throughout construction of the project.

00305.05 3D Engineered Models - If the Contractor elects to use the 3D Engineered Models to control the work, provide unstamped 3D Construction Models according to 00150.35 which include the following:

• A detailed outline and list of the pay items and Work that will be controlled by the 3D Construction Models.
• A narrative outlining any differences between the Agency-prepared 3D Engineered Models and the 3D Construction Models.
• A copy of the 3D Construction Models that will be used by the Contractor’s equipment for machine guidance or verification, that include and represent the Agency-prepared 3D Engineered Models with changes identified in the narrative. Provide files in LandXML format or as directed.
Private sector example shown
CNC Milling Machine
Used to carve 3D Model
K&E Excavating
3D Model from the transmitted Bid Plans, used for:

• Constructability

• Staging

• Crew-level discussions

I-5 Woodburn Interchange
CNC Milled Styrofoam Model
K&E Excavating
I-5 Woodburn Interchange
3D Design, AMG Construction
K&E Excavating
2016 Bid for a Large Earthwork and Multi-plate Culvert Project

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<td>HIGHWAY</td>
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<td>CORVALLIS-NEWPORT, US-20</td>
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<td>SCARSELLA BROS INC, KENT, WA 98031</td>
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AMG is competitive
Stakeless Construction based on 3D Design

Improves safety, reduces personnel in work zone, & shortens construction time
Stakeless Construction based on 3D Design

GPS Machine Guidance - rough grading
Stakeless Construction based on 3D Design

Laser Survey Machine Guidance - fine grading

US140, Bly Mountain
Stakeless Construction based on 3D Design

US140, Bly Mountain
Stakeless Construction based on 3D Design

Better slope shaping improves erosion prevention measures

culvert
Stakeless Construction – Milled to a Profile

Smother and longer lasting pavements
Stakeless Construction – Paved to a Profile

Laser guidance results in faster construction
Stakeless Construction – self steering & profile

0.001’ = 3 sheets std. paper
Stakeless Construction – Higher quality

Straighter, smoother, & efficient material usage
Future Concepts
Survey Grade GNSS Tablet

- Can be used handheld or attached to a rod
- Oregon DOT has devices assigned to each crew
- Training & support is provided across the State

Traditional Use

Station and Offset on Paving Projects

Utility locations/as-builts
Measuring quantity and location

Pay Item Use
Pay Item for Bridge Repair

Banfield Bridge, Portland, OR
Bridge deck delamination surface preparation
Paid by the square yard
Snow Blowing US26 near Mt. Hood

How to avoid guardrail & road edge
even at night
A busy operator
Typical Mount Hood Highway
Snowplow with GPS for Guidance
New technology and collaboration for speed change implementation
Ground Penetrating Radar
A Work in Progress
Utilities, Bridge Decks, Pavements?

That looks reasonable...

Second pass.

Operator error? Get a shovel.
3D Pavement Milling
Could this replace truck tickets?

- Original surface
- Milled Surface
- New Surface
- Density
A Contractor’s discussion of 3D AMG
Thank you
Questions?

Tracks in my mud???