Workflow Changes to Support Digital Construction – Design Deliverables

Gabe Nelson, P.E.
Snyder & Associates, Inc.

Tech Center

Overview

- Getting Started
- Understanding Deliverables
- Quality Control of 3D Deliverables
- Level of Detail

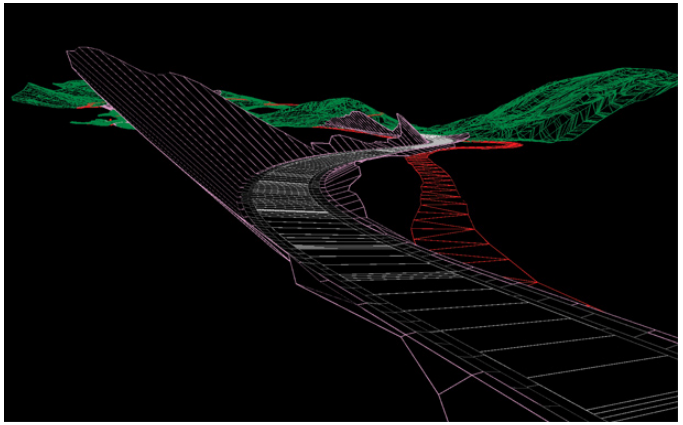
Tech Center

What Is a 3D Engineered Model?

3D Engineered Model

- 3D Engineered Model: A digital graphical representation of proposed facility/site data consisting of x, y, and z coordinates for producing objects in three-dimensions to communicate design intent useful for visualization, analysis, animation, simulation, plans, specifications, estimates production, and life-cycle asset management

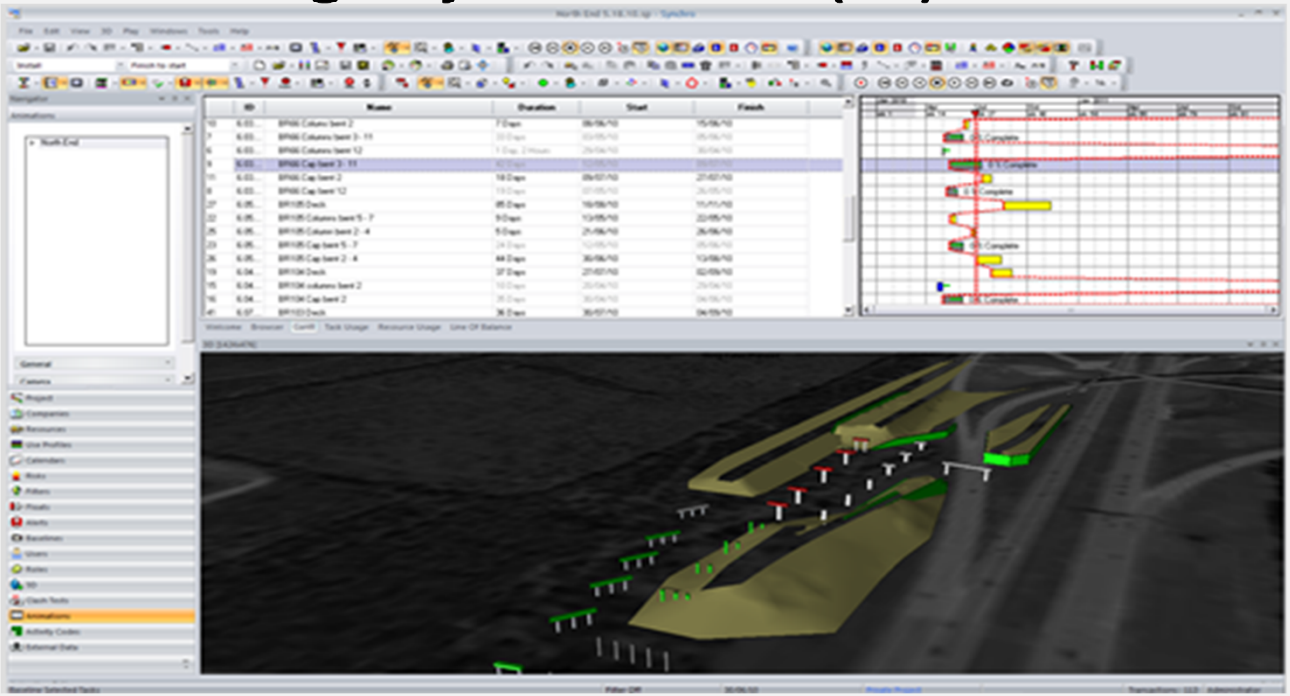
3D Engineered Model in Wireframe View



Tech Center

Incorporating Cost and Schedule Information

Adding Project Schedules (4D)



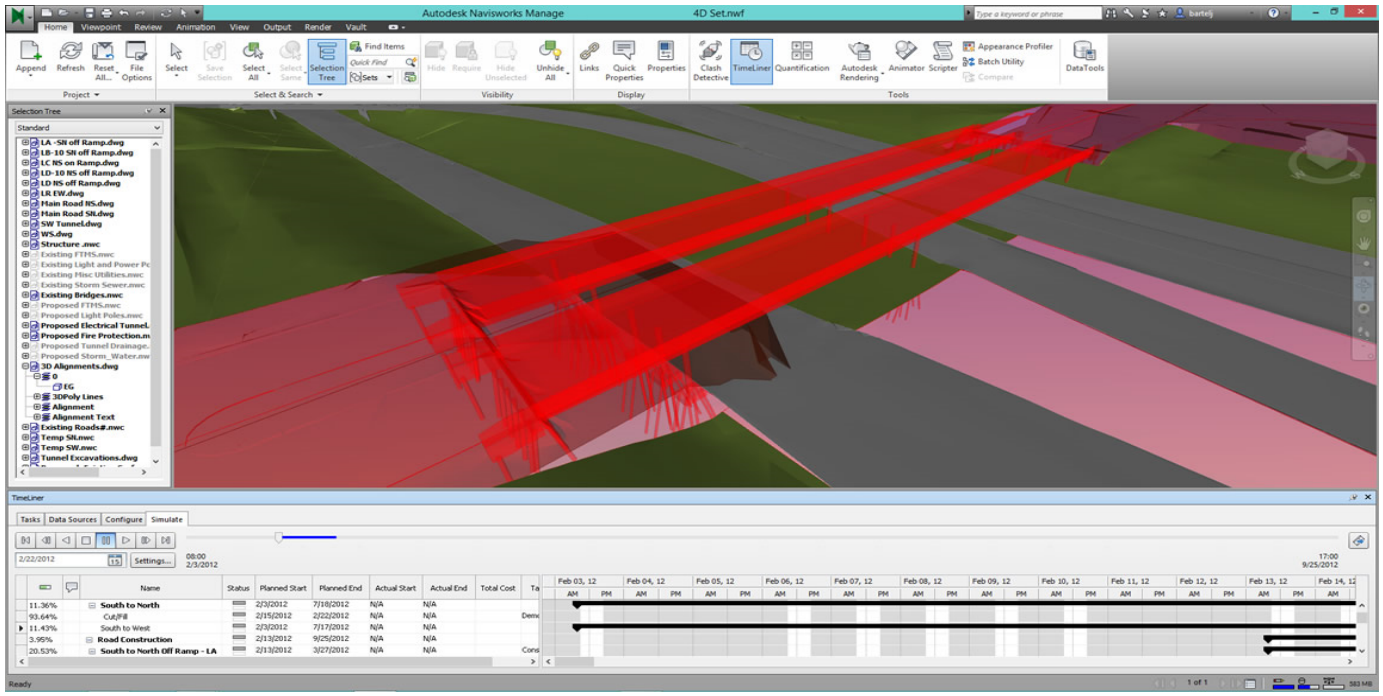
Screenshot of 4D Model

Tech Center

Incorporating Cost and Schedule Information

- Adding Project Cost Information (5D)
  - ➢FHWA defines 5D modeling as:

"A 4D model intelligently linked with cost information for a project"



5D Model Screenshot

How to Get Started

- Establish Goals up Front!:
  - Calculation of Quantities
  - Visualization/Virtual Reality
  - Design Analysis/Quality Control
  - Automated Machine Guidance
  - BIM Execution Plan
    - What are we modeling?
    - When are we modeling it?
    - To what level of detail are we modeling it?

Tech Center

Level of Accuracy

ITEM 625.1001 11 - 3D CADD MODEL

MSE-Proposed					
Straps	DGN / XML	<18 mm	3D	3D	Yes
Footings	DGN / XML	<18 mm	3D	3D	Yes
Top	DGN / XML	<18 mm	3D	3D	Yes
Coping	DGN / XML	<18 mm	3D	3D	Yes
Cast-in-Place-Proposed					
Stone	DGN / XML	<18 mm	3D	3D	Yes
Piles	DGN / XML	<18 mm	3D	3D	Yes
Top of Footings	DGN / XML	<18 mm	3D	3D	Yes
Face of Wall	DGN / XML	<18 mm	3D	3D	Yes
Coping	DGN / XML	<18 mm	3D	3D	Yes

Tech Center

Level of Detail

- 100 – Conceptual
- 200 – Approximate Geometry
- 300 – Precise Geometry
- 400 – Fabrication
- 500 – Asbuilts

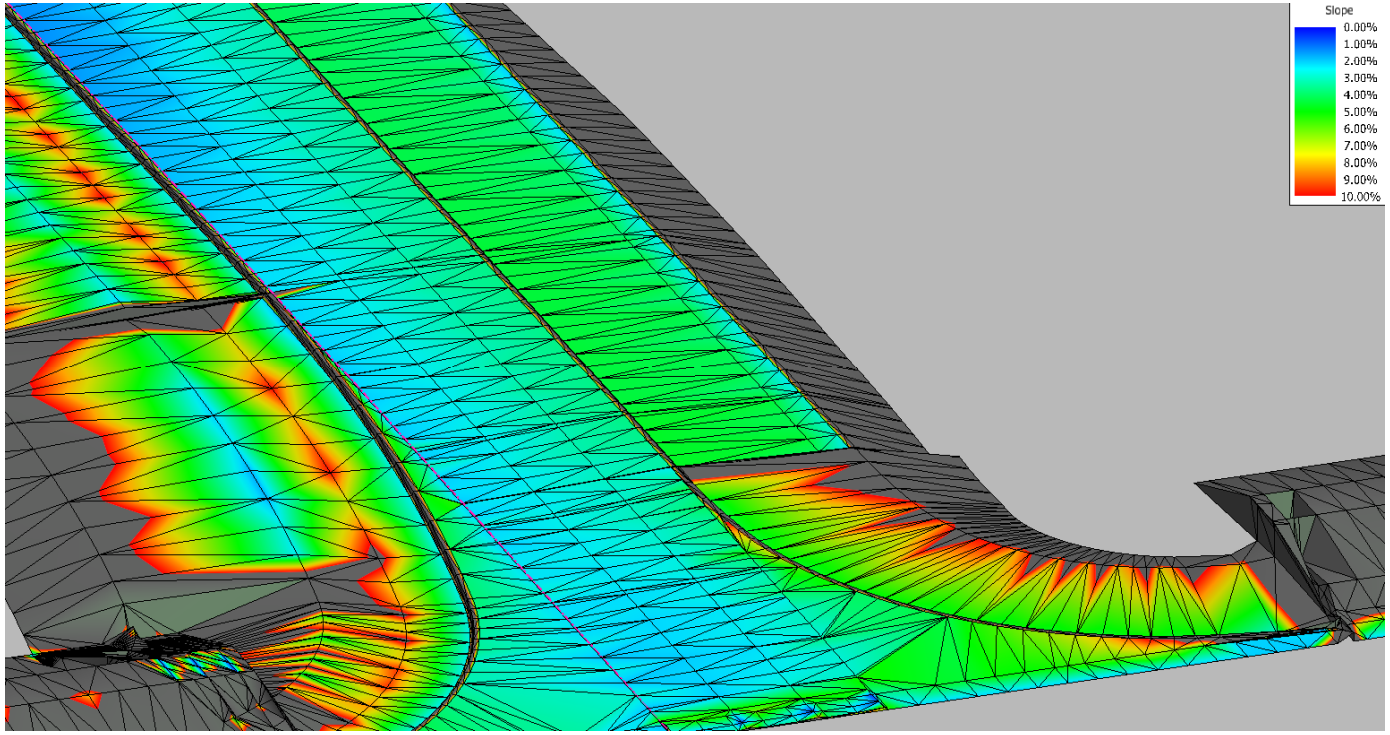
Table 4 - 3D CADD, 4D and 5D CIM MODEL LEVEL OF DEVELOPMENT BY DISCIPLINE

Discipline	Model	LOD
Exist Conditions	Surface Terrain DTM	300
Exist Conditions	Bathymetry DTM	300
Exist Conditions	Elevated Structure including foundations, piers, abutments, main truss, approach framing and decking	200
Exist Conditions	Buildings to be demolished	200
Exist Conditions	Buildings – Context	100
Exist Conditions	Local Streets, other topographic features required for context	100
Proposed Civil	Local Streets – Paving	200
Proposed Civil	Local Streets – Relocated	300
Proposed Civil	Grading	300
Proposed Civil	Utilities	200

Tech Center

Enhanced Quality Assurance in Design

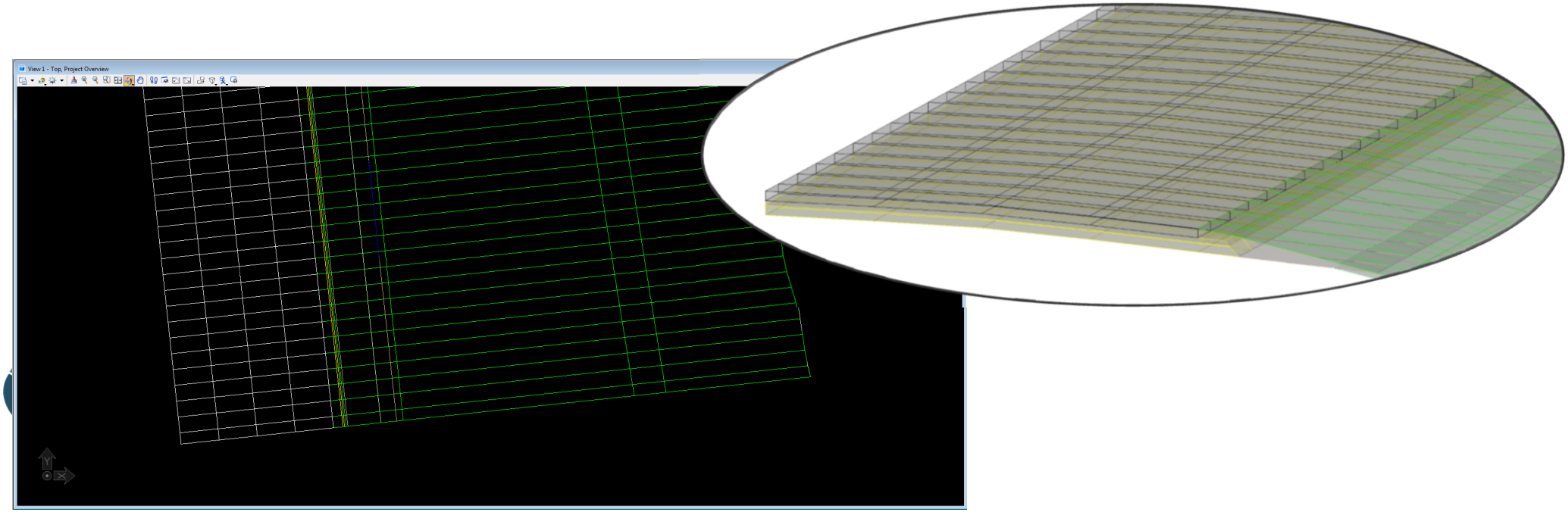
- 3D and Drivethrough views
- Clash Detection
- Clearance Measurements



Tech Center

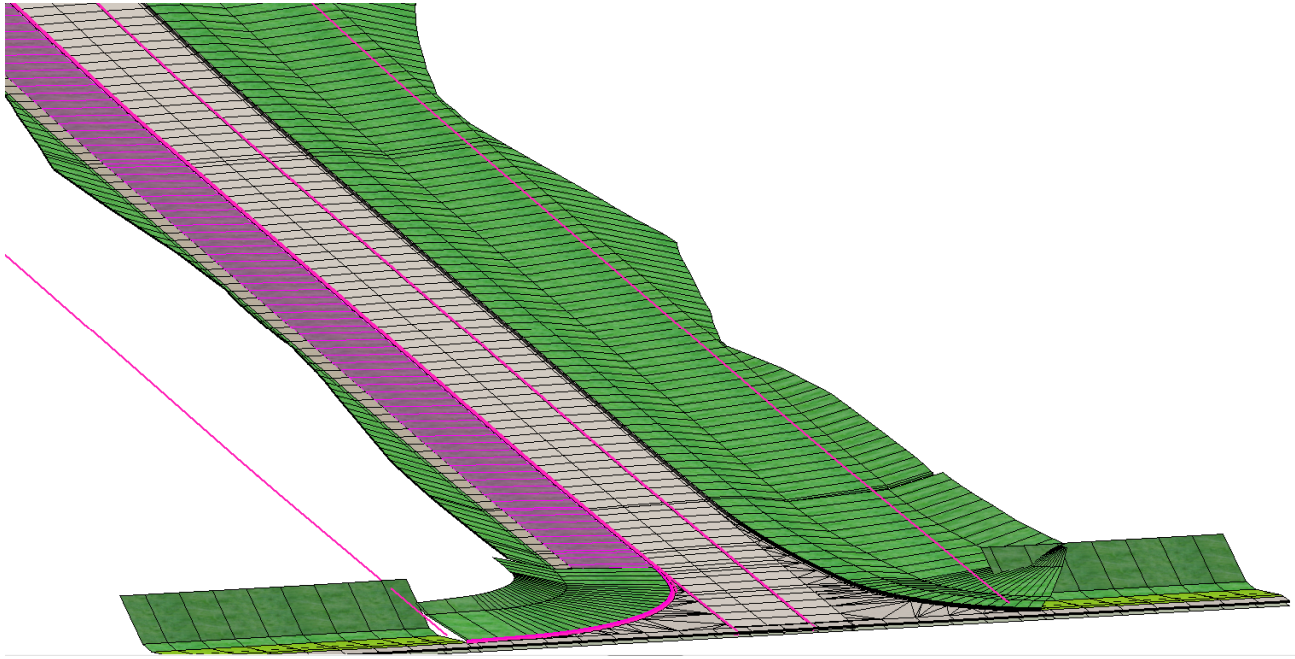
Level of Detail – AMG Deliverables

- Depends on Ultimate Use
- Grading – 10’- 25’ is fine
- Paving 1’-5’ is better
- Needs to be closer in Vertical Curves and Superelevation Transitions



Understanding Deliverables

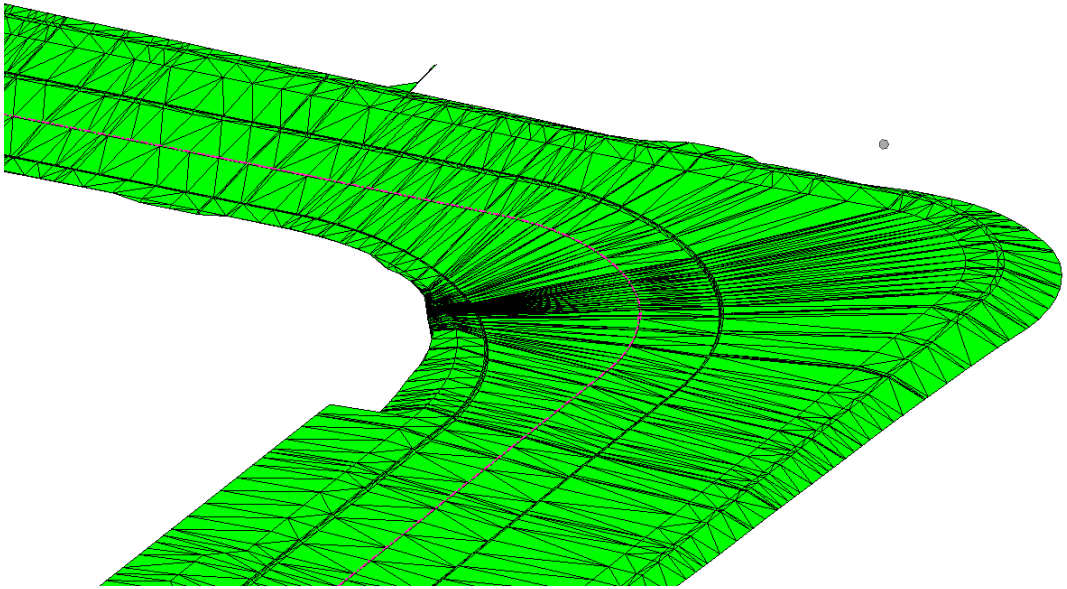
- Deliverables are Different for Grading and Paving
- Surfaces
- Accuracy
- 3D Breaklines
- Alignments



Automated Machine Guidance

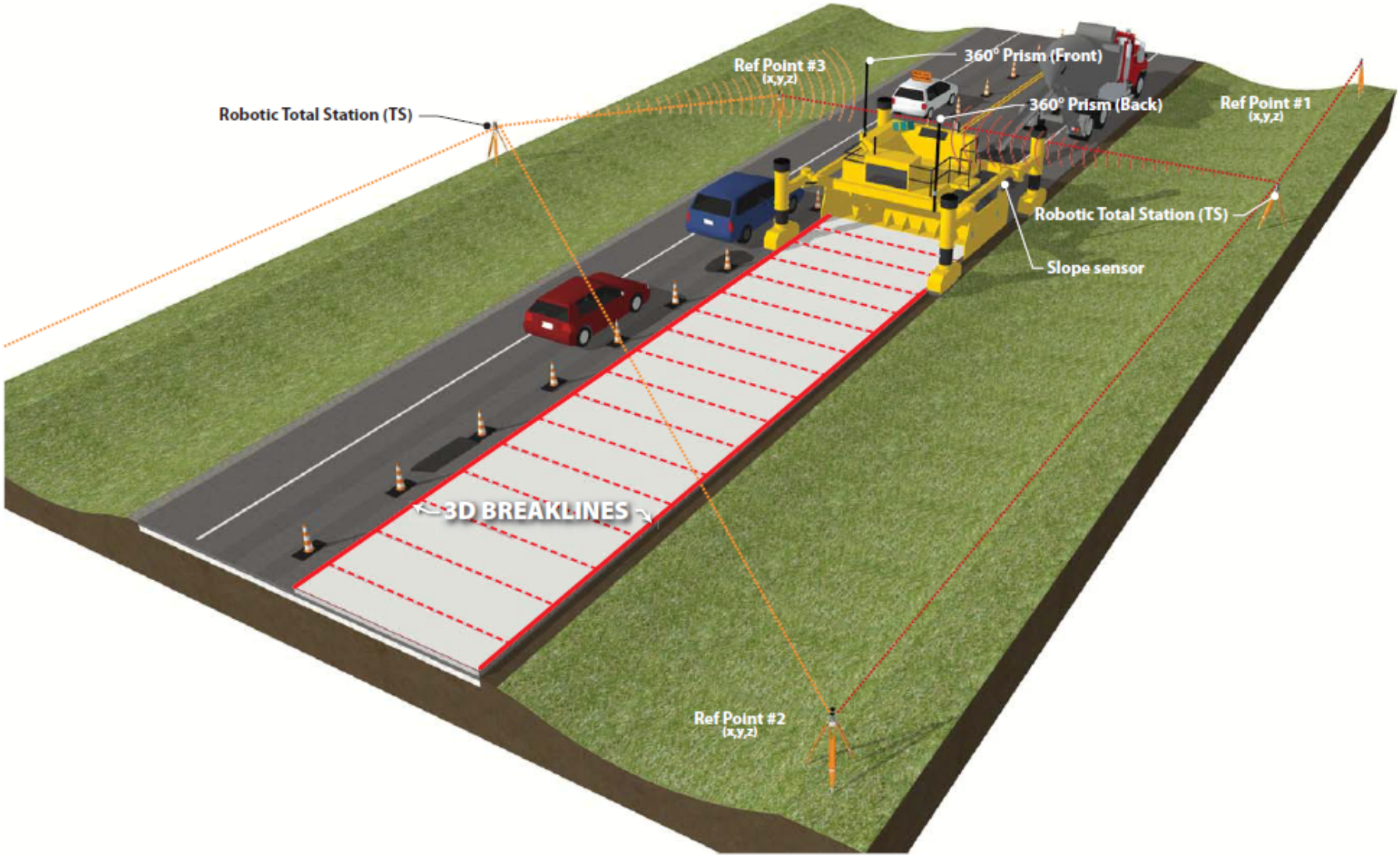
- Grading Deliverables
  - Surface – Triangulated Network (LandXML)
  - 3D Breaklines
- Paving Deliverables
  - 3D Breaklines

Photos Courtesy of Michigan Department of Transportation Photography and Video Services Unit

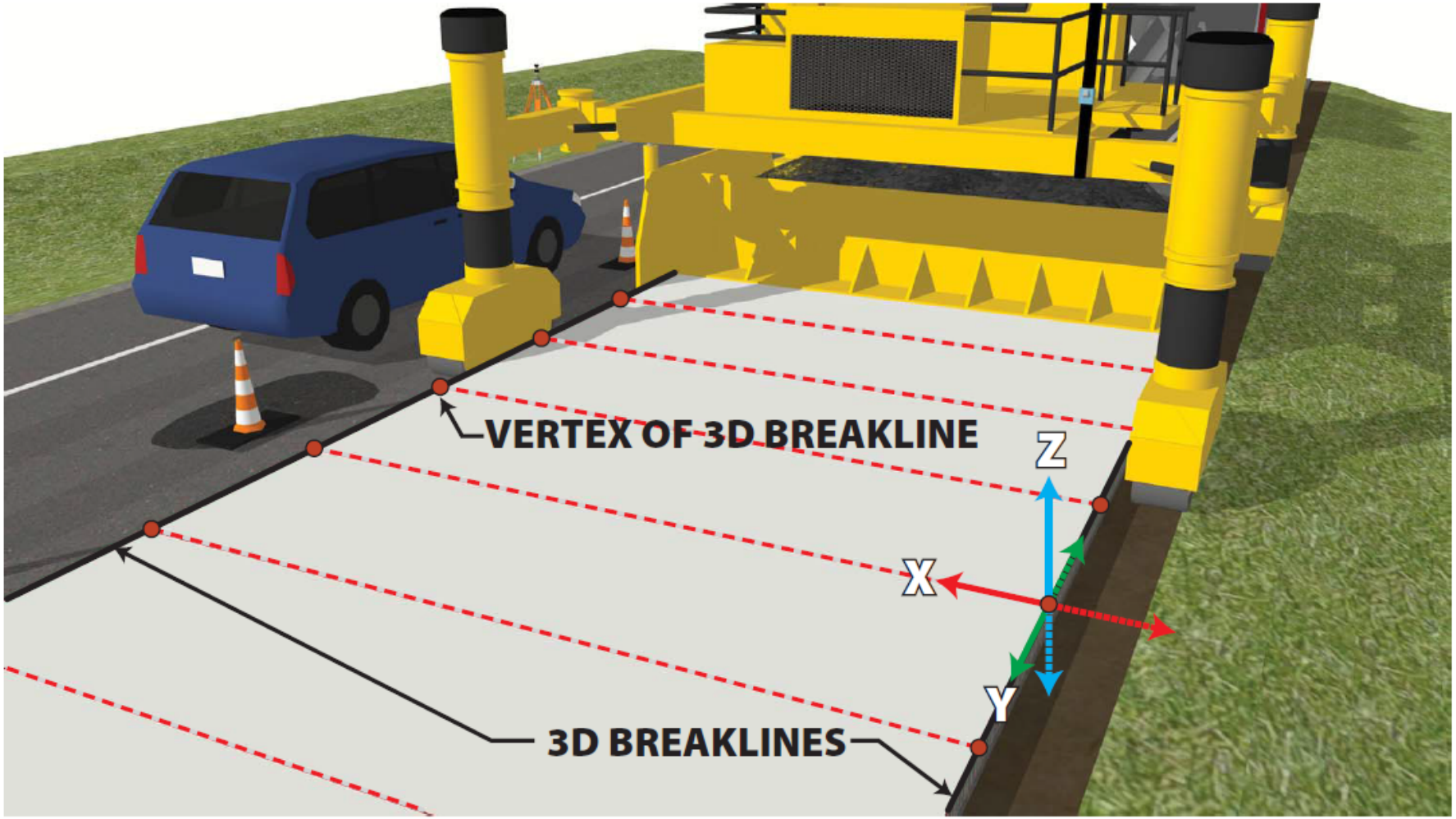


Tech Center

AMG Paving - Inputs



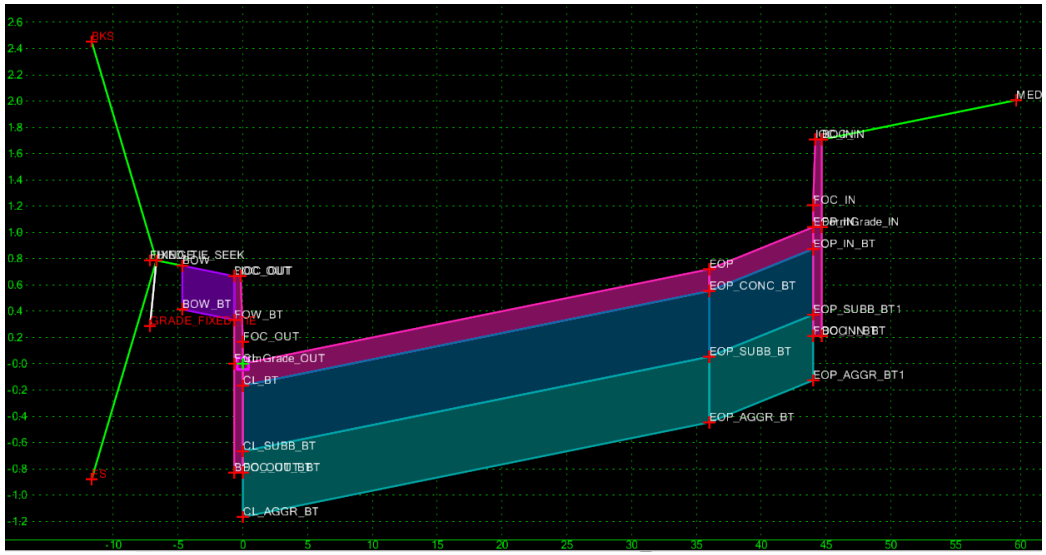
AMG Paving - Inputs



Tech Center

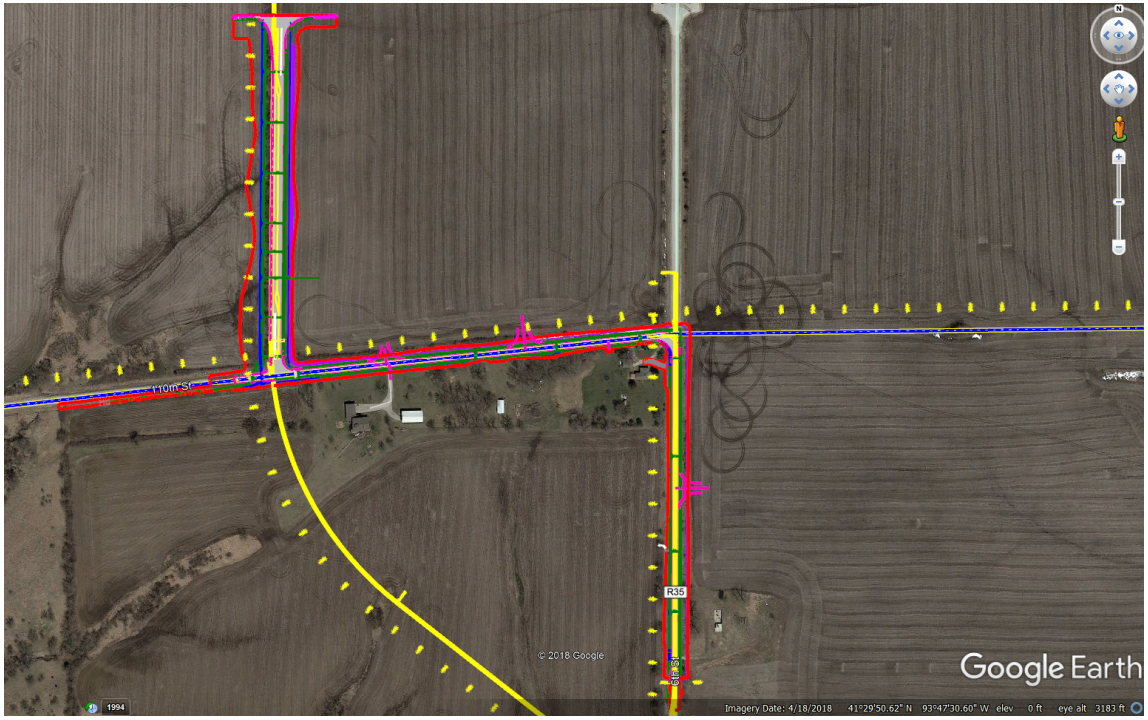
CAD Standards

- Level/Layer File names
- File Naming
- Alignments
- Templates
- Point Controls
- Makes it easier on your designers and on downstream users
- Document the files



AMG - Deliverables

- Alignments
  - LandXML format
- Grading Surfaces
  - LandXML format
- Paving
  - DXF
- Other CAD Files
- KMZ files



Tech Center

Other Considerations

- Delivery of Data to Contractor
  - Pre-letting or Post-Letting

- Pre-letting allows the contractor to factor in the quality of the data they are getting

- Does not give any contractor a competitive advantage

Tech Center