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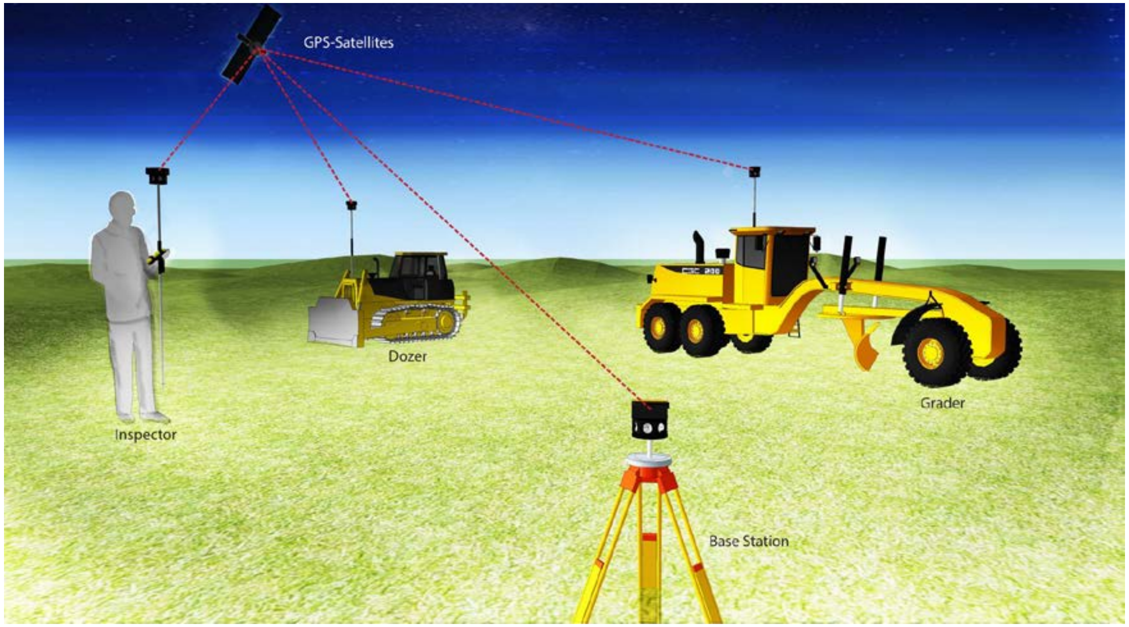
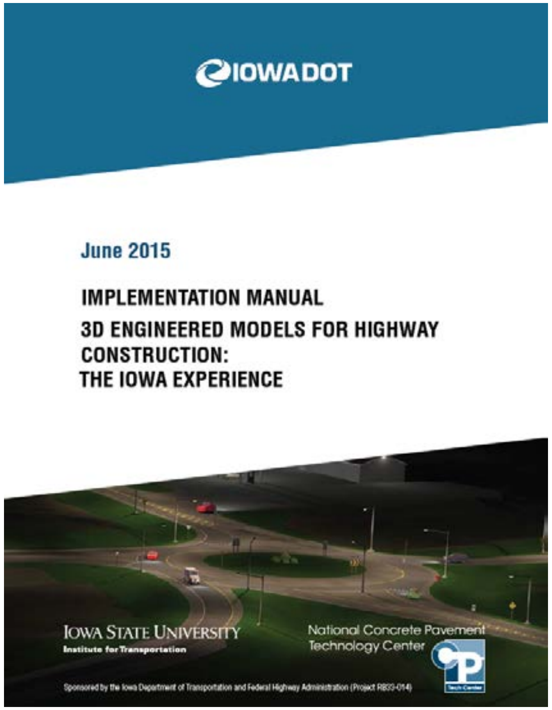
NOVEMBER 14, 2018



ENHANCED DELIVERABLES AND THE DIGITAL JOBSITE

Background

- CP Tech Center/Snyder & Associates team
- EDC-2 3D Engineered Models
- EDC-4 e-Construction (Digital Construction Inspection)



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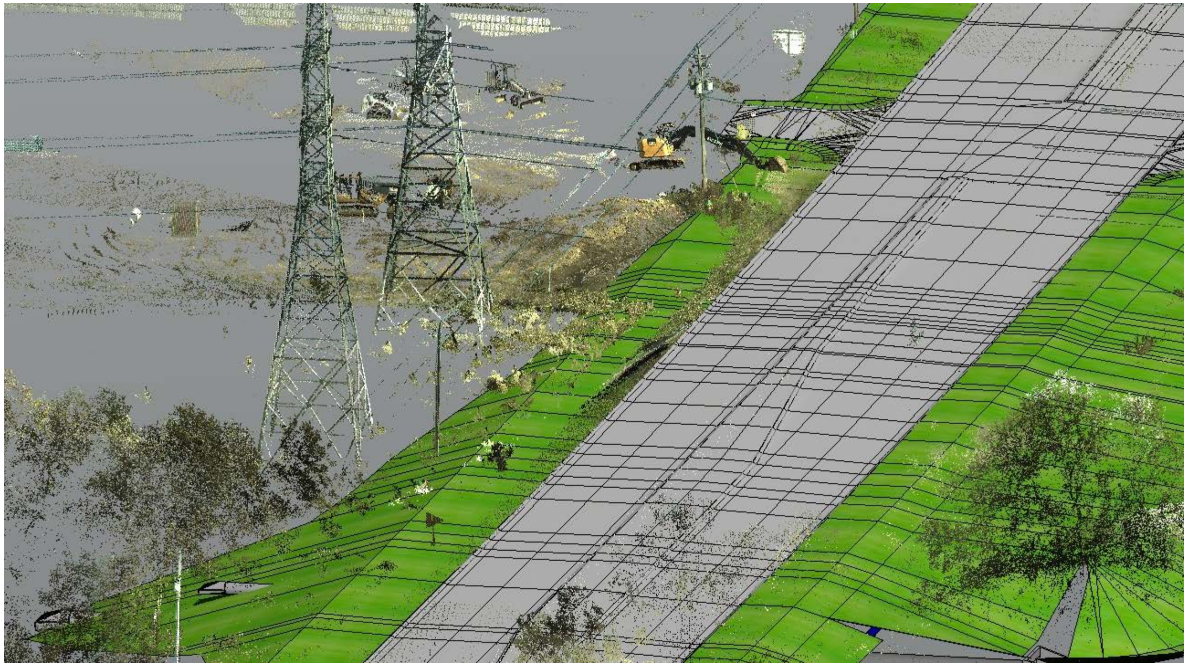
What is a 3D Engineered Model

- 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.

What is a 3D Engineered Model

- Surfaces – Existing/Proposed
- Utilities
- Structures
- Time
- Cost



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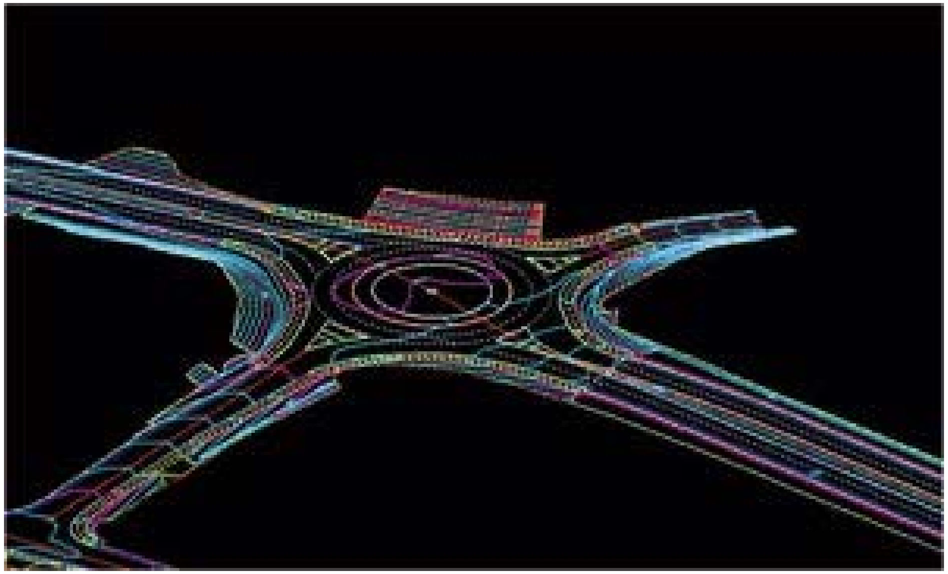
Benefits of 3D Engineered Models

- Increased efficiency
- Early detection of issues
- Facilitates stakeholder buy-in
- Improves communication
- Models for presentation

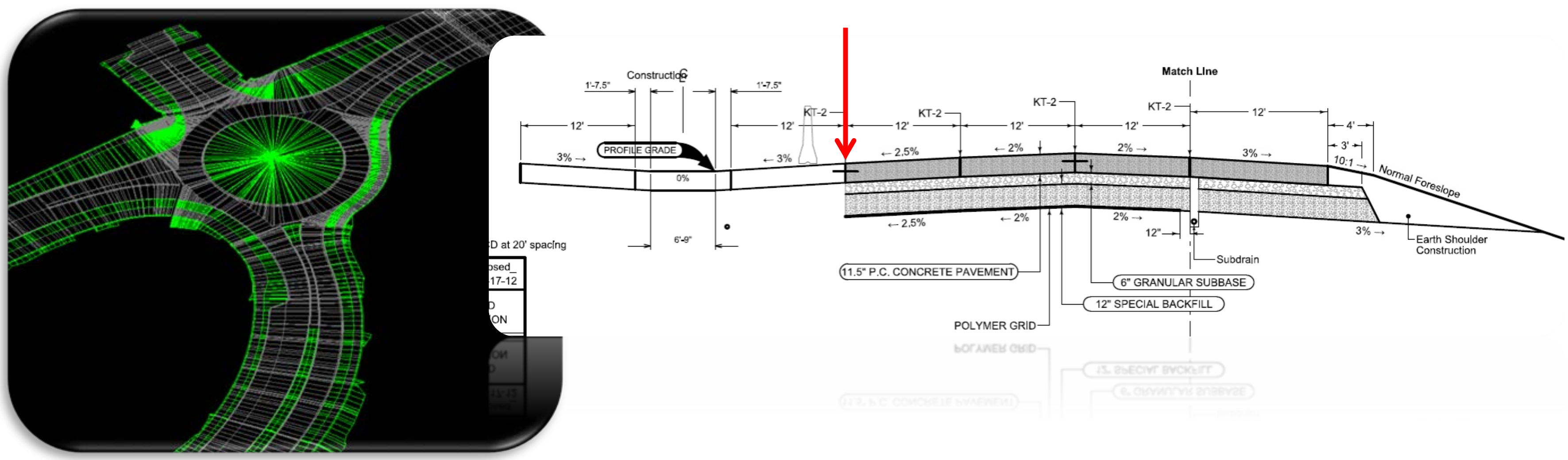


Why should you care?

- Benefits to Owners/Designers
  - Increased Efficiency
  - More Accurate Quantity Takeoffs
  - Visualization Capabilities
  - Enhanced Quality Assurance in Design
  - Data Streamlining/Enhanced Deliverables

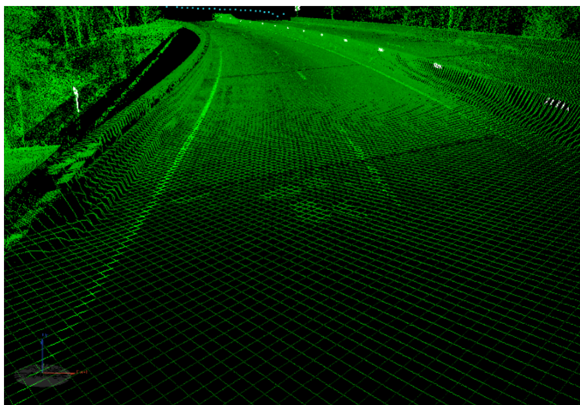
Increased Efficiency

- NO! Not less time designing – More Time
- More design iterations can be examined
- 2D Plans are the result of a 3D Model



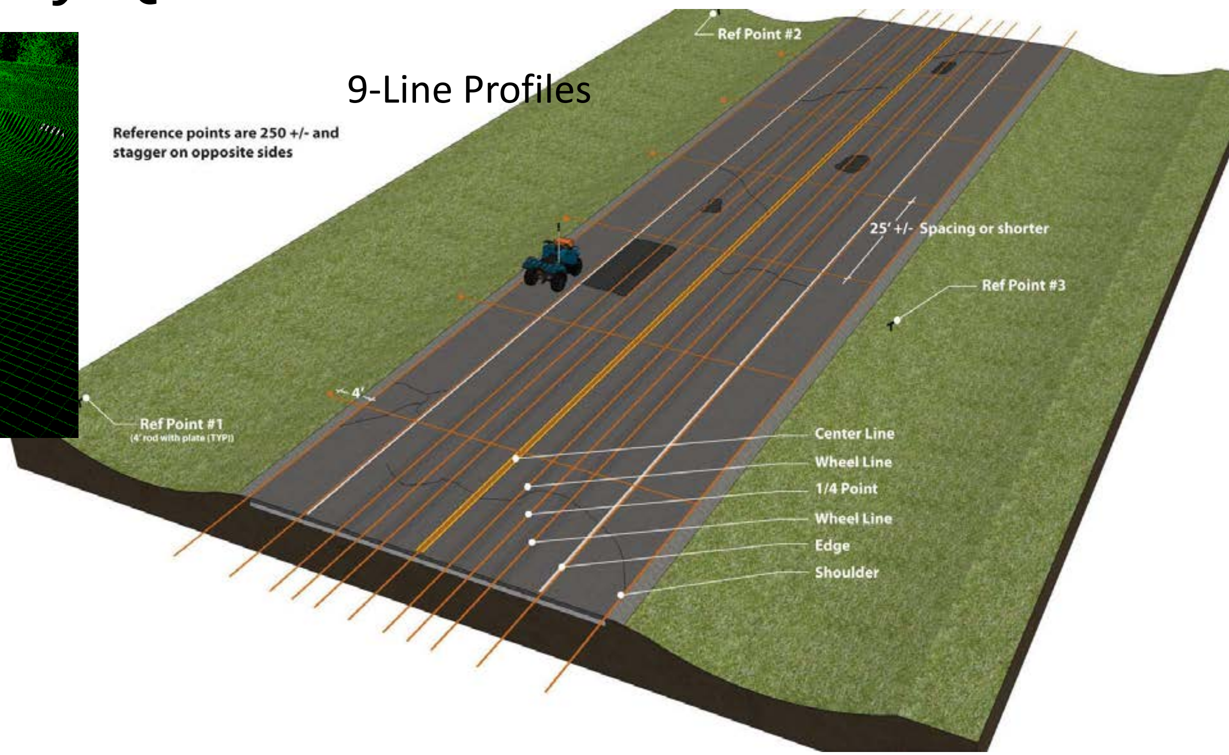
Accurate Quantity Takeoffs

- Surface to Surface Comparisons
- Optimize Overlay Quantities



Mobile/Static Scanning

9-Line Profiles

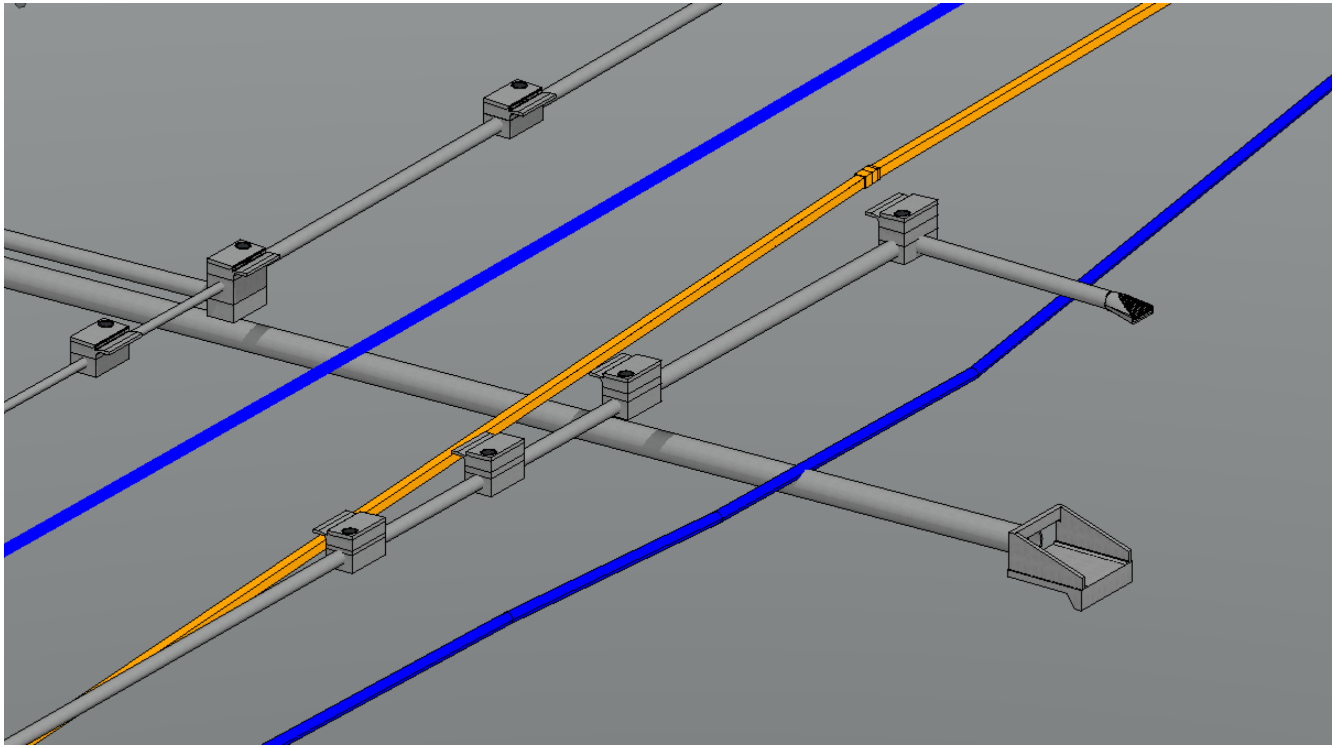


Visualization Capabilities

Photo courtesy of Snyder & Associates, Inc.

Enhanced Quality Assurance in Design

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



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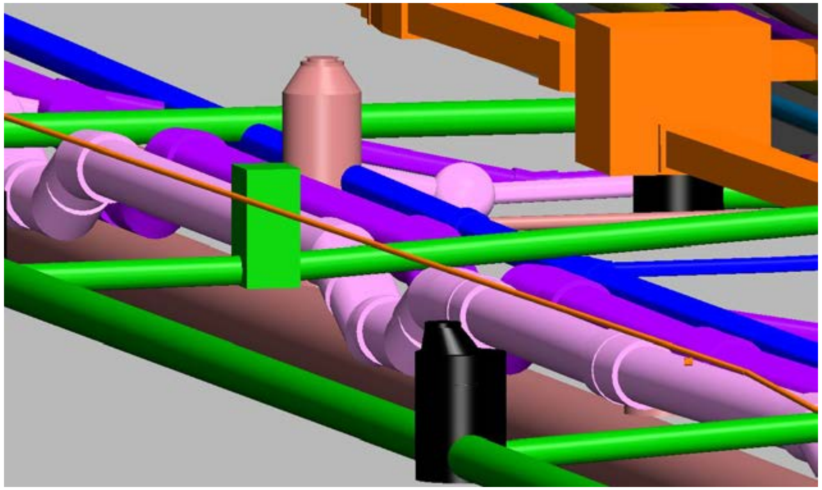
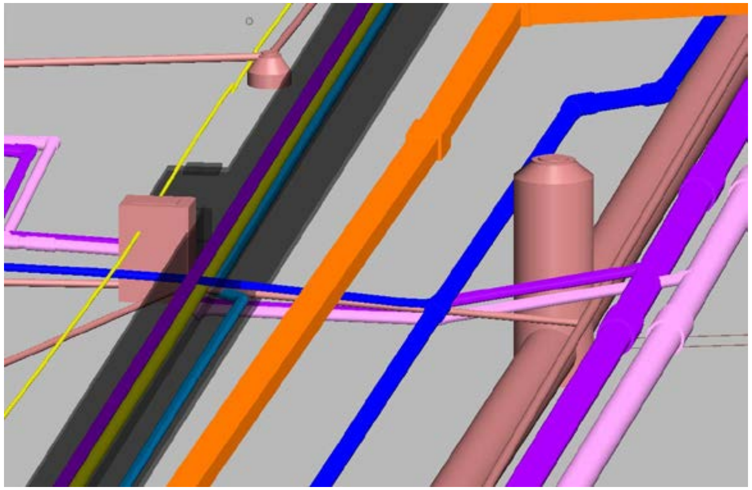
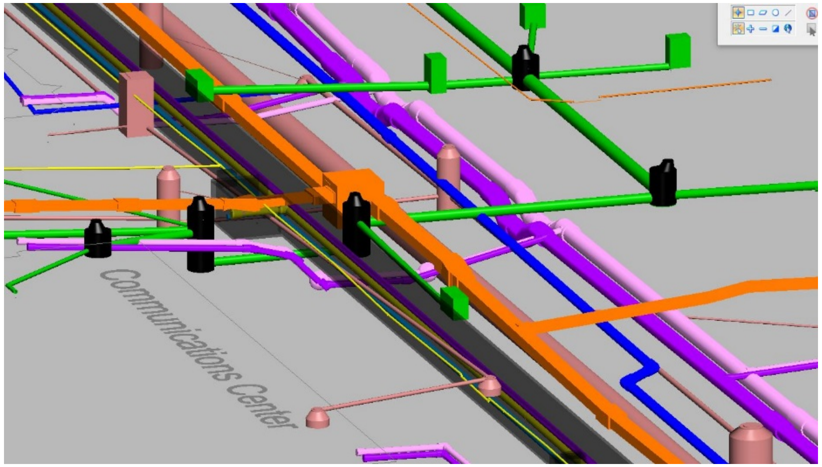
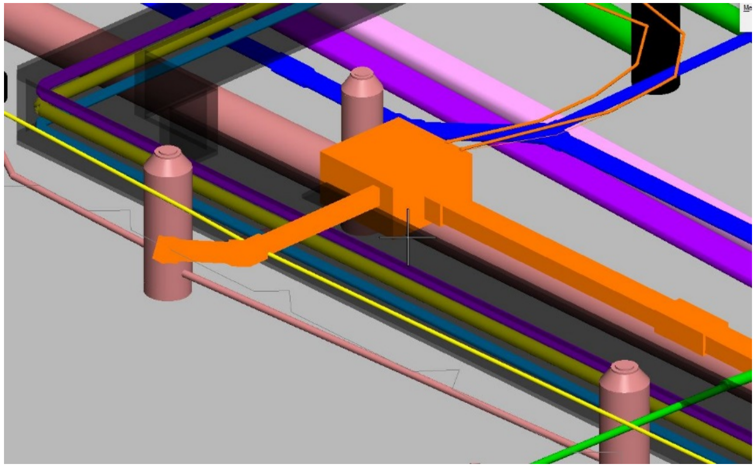
Enhanced Quality Assurance in Design









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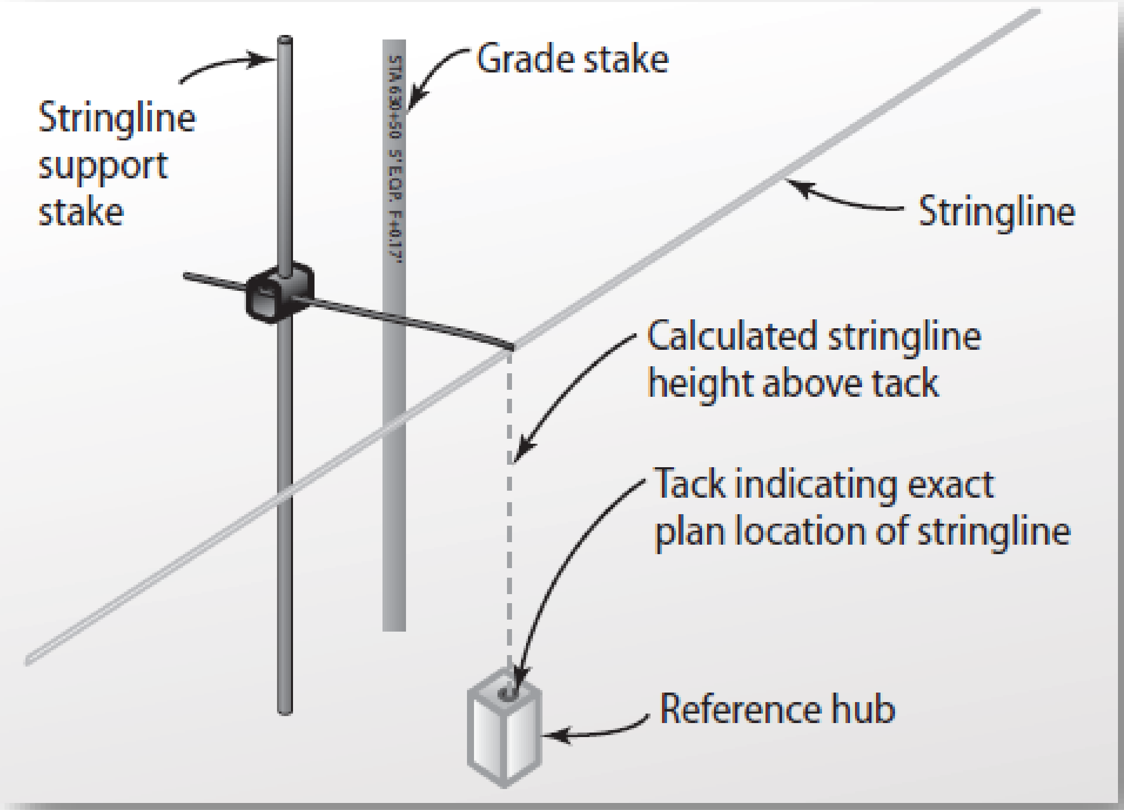
Data Streamlining

- From Designer to Contractor
- Introduces Fewer Chances for Error



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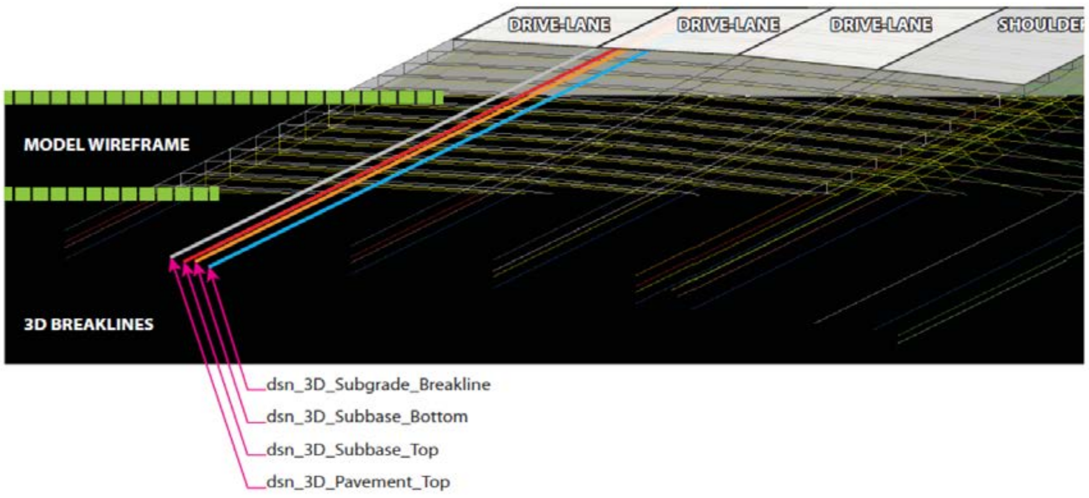
CAD Standards

- Level/Layer File names
- File Naming
- Alignments
- Templates
- Point Controls

Figure 5H-1.02: 3D Break Lines Contained within the 3D Engineered Model



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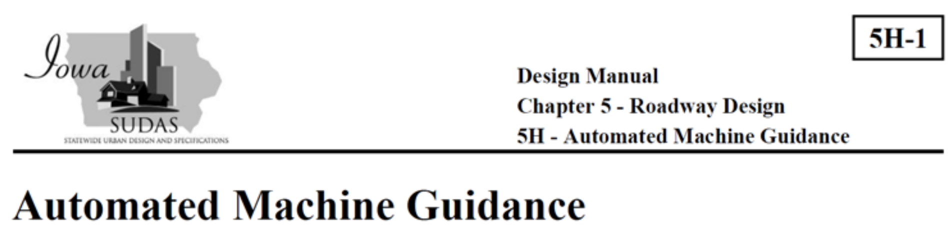
Data Transfer

- Universal Data Types are key!
  - Proprietary data types are only good when both parties are using the same software – typically not the case
- CADD files = DXF
  - 2D linework (i.e. Boundary/ROW)
  - 3D linework (i.e. Roadway section breaklines, terrain breaklines)
  - 3D modeled solids (i.e. Bridge abutments, piers, piles, girders, etc.)
- Alignments and Surfaces = XML
  - Horizontal Alignments and Profiles
  - Digital Terrain Models (DTMs), Triangulated Irregular Networks (TINs), etc)
- LiDAR Data = E57
  - Aerial LiDAR
  - Terrestrial LiDAR
  - Mobile LiDAR


5H-1

Iowa SUDAS

Design Manual
Chapter 5 - Roadway Design
5H - Automated Machine Guidance

Automated Machine Guidance

Electronic File Needs

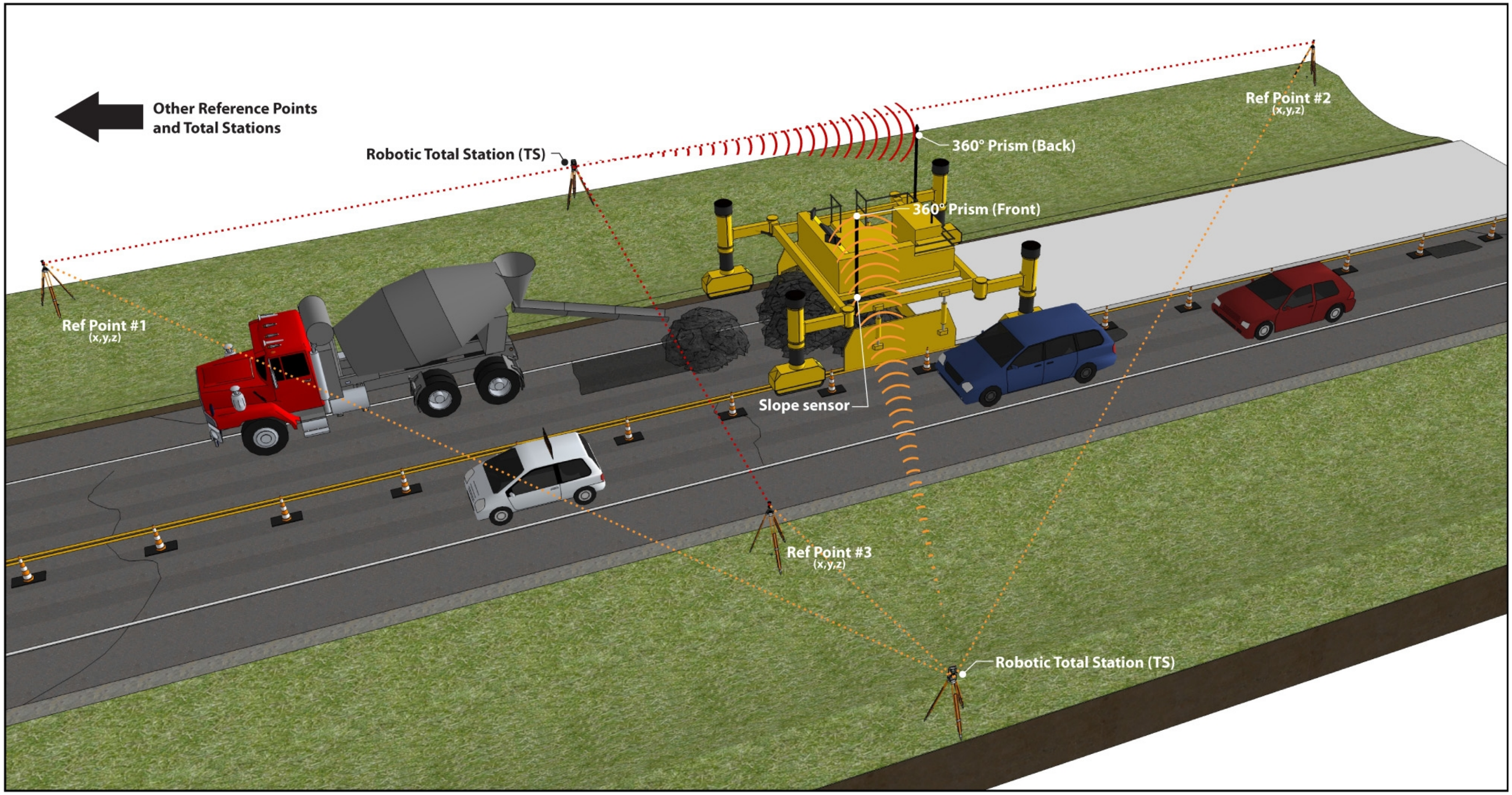
For Machine Control Grading

- Surface (Triangular Irregular Network)
- Linework File (Horizontal Only)
- File Types – XML's or .DXF's

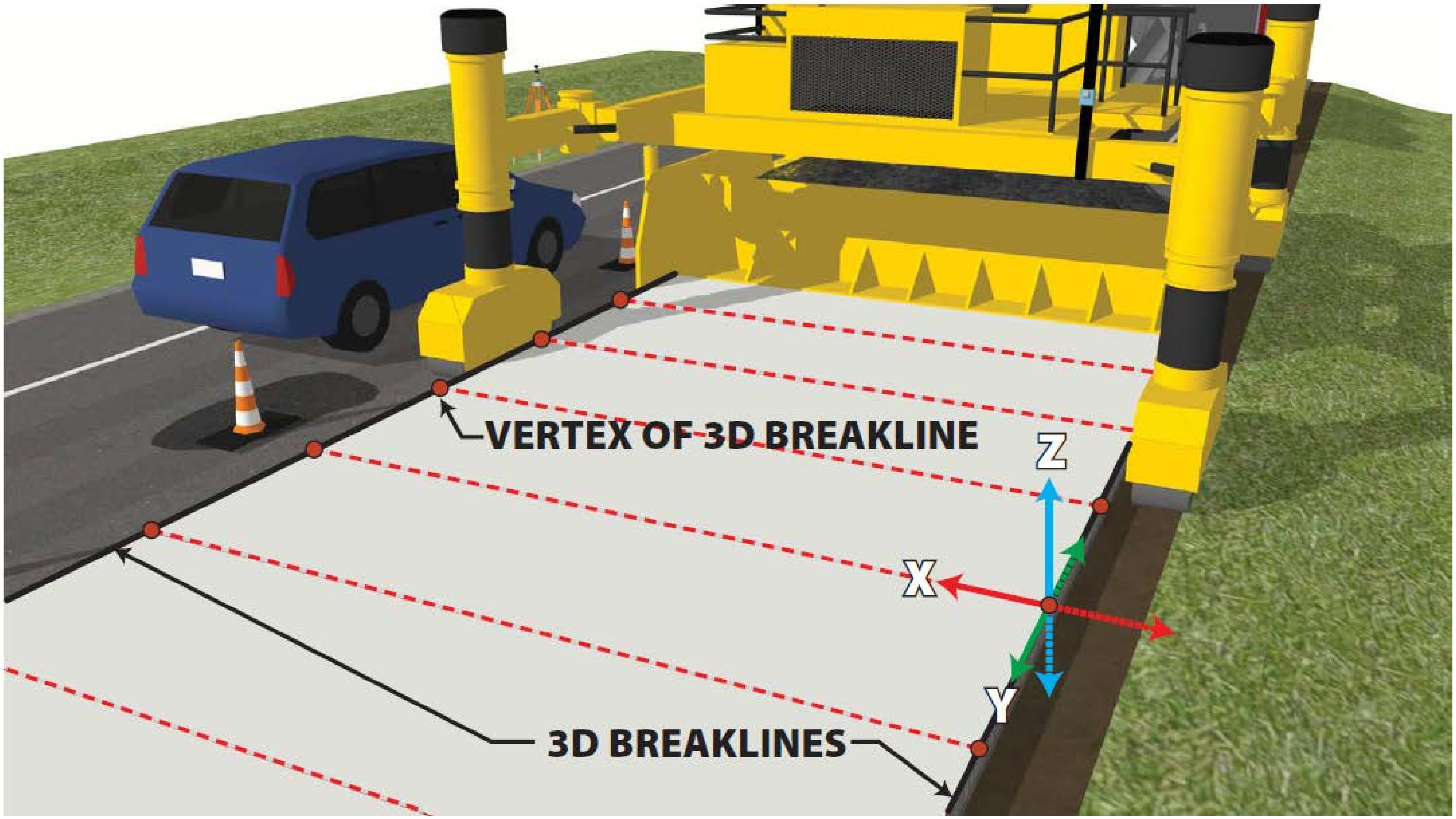
For Machine Control Paving, Milling, Trimming

- 3D Polylines – XML's or DXF's
- Alignment – XML's
- Transition Locations (Supers)

AMG Paving - Setup



AMG Paving - Inputs



Survey Needs

- Tie In shots verified
- Tight Horizontal and Vertical Control
- Control points every 500’ on each side of road staggered

Digital Construction Inspection

- Designer's role should continue into construction
- Designer reviewing contractor's model
- Who is creating the model of record?
- Handling Changes in Construction
- How much of a surveyor will our construction inspectors have to become?

Contractor Work Plan

SUDAS Standard Specifications

Division 1 - General Provisions and Covenants
Section 1050 - Control of Work

1.15 ADDITIONAL CONTRACTOR RESPONSIBILITIES

If a form of automated machine guidance (AMG) is used for grading or paving operations, the following is required:

A. At least one week prior to the preconstruction meeting, submit to the Engineer for review a written AMG work plan which indicates the following:
   - Equipment type
   - Control software manufacturer and version
   - Proposed location of GPS base station for broadcasting differential correction data to rover units
   - Proposed locations where AMG will be utilized

B. Provide Engineer with up to 8 hours of formal training on Contractor’s AMG systems.

C. For grading contracts, provide a rover for use by the Engineer.

D. Check and recalibrate, if necessary, the AMG system at the beginning of each work day.

E. Contractor will bear all costs associated with use of the AMG system, including but not limited to reconstruction of work that may be incurred due to errors in application of the AMG system. Correction of grade elevation errors and any associated quantity adjustments resulting from the Contractor’s activities are to be done at no cost to the Contracting Authority.

How Much Survey in Construction?

- Field Calibration of Model and Survey Data Collection
- Selecting the Right Tool
- Hardware and Software Skills
- Greater Integration of Workflows with Design

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GPS Rovers

- FHWA vision – Every Inspector has one of these

Uses

- Checking Grade (subgrade)
- Measuring Quantities (linear, area)
- Check Station/Offset Positioning
- Site Mapping
- Utility Locates/Conflict Documentation
- Utility Asbuilts

Other Tools

- Total Stations
- LiDAR
- HyDrone
- UAS

All tools are not created equal

Method	Network Accuracy (RMS)
Fixed Wing Aerial LiDAR/Photogrammetry	3" – 6"
Low Altitude Helicopter LiDAR/Photogrammetry	1" – 2"
Mobile LiDAR	½" – 1"
Tripod-Mounted Static LiDAR	¼" – ½"
Terrestrial Surveying: RTK GNSS/GPS (AMG too)	½" – 1"
Terrestrial Surveying: Total Station/Digital Level	<¼" – ½"

Contact Information

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