Applications of 3D Models on the Construction Site

April 2, 2014

1:00 pm – 2:30 pm EST

Every Day Counts

U.S. Department of Transportation
Federal Highway Administration

Welcome, Introductions and Safety Message

Douglas Townes, P.E.
FHWA Resource Center

U.S. Department of Transportation
Federal Highway Administration

What type of organization do you represent?

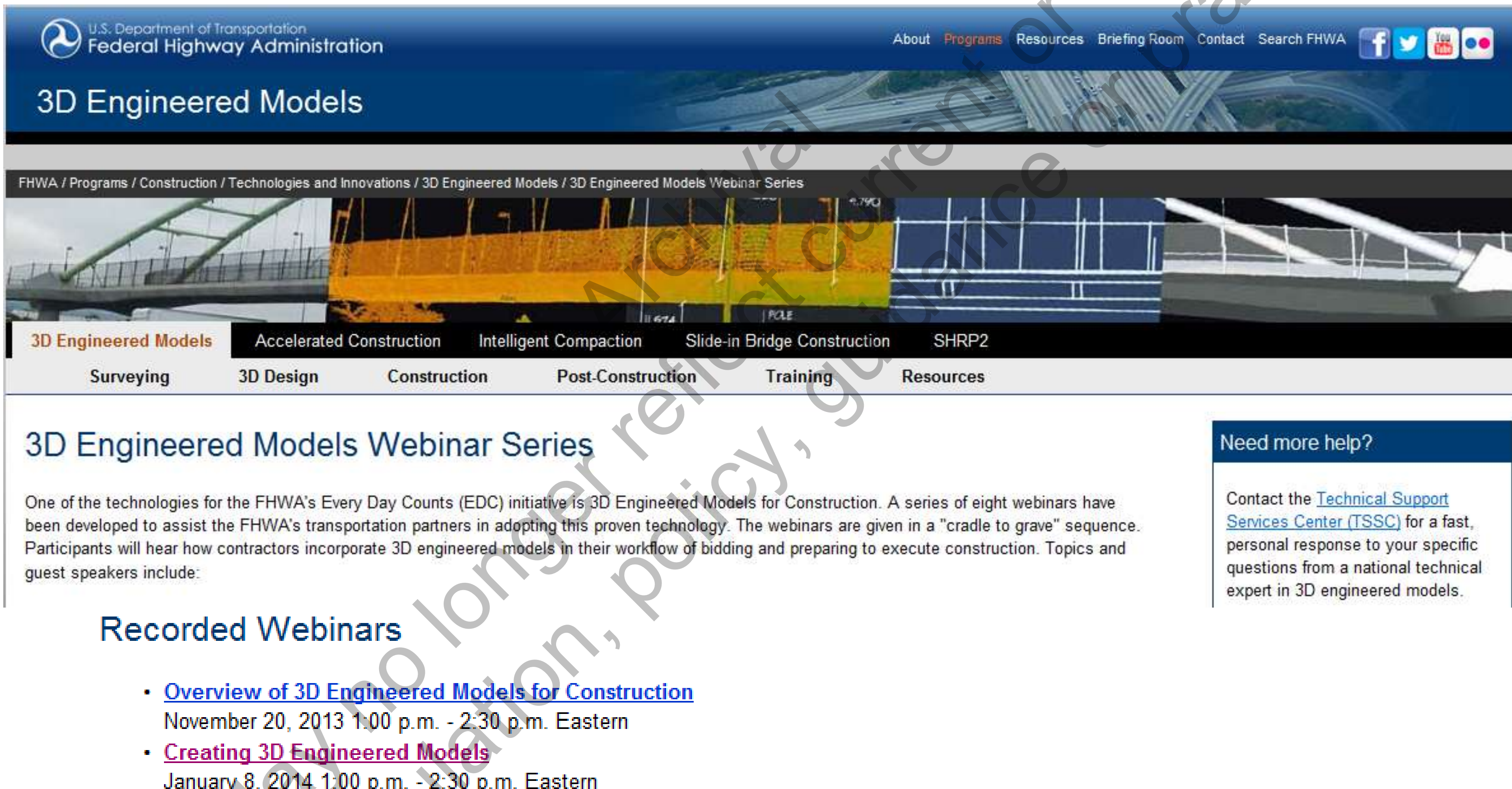
- DOT Construction Division
- DOT Design Division
- DOT Survey Division
- DOT Other Division
- Local Authority
- FHWA Division Office
- FHWA Other Office
- Other Federal Agency
- Contractor
- Consultant
- Vendor
- Industry Representative

3D Engineered Models Webinar Series

Webinar 1: Overview of 3D Models for Construction
Webinar 2: Creating 3D Engineered Models
Webinar 3: Applications of 3D Models in the Contractor's Office
Webinar 4: Applications of 3D Models on the Construction Site
Webinar 5: Managing and Sharing 3D Models for Construction
Webinar 6: Overcoming Challenges to Using 3D Models for Construction
Webinar 7: Implementing 3D Engineered Models for Construction
Webinar 8: Adding Time, Cost and other Information to 3D Models

Recordings of Previous Webinars

http://www.fhwa.dot.gov/construction/3d/webinars.cfm



Social Media

Tweet along on Twitter:

#EDC2 @USDOTFHWA

Today's Speakers

Speaker	Topic
Douglas Townes (FHWA-RC)	Welcome, Introductions and Safety Message
Lance Parve (Wisconsin DOT)	Supporting 3D/4D Construction Applications in Preconstruction
John Lobbestael (Michigan DOT)	Supporting AMG on site for QA
Francesca Maier (Parsons Brinckerhoff)	Moderated Question & Answer Session
Douglas Townes (FHWA-RC)	Information on Next Webinar and Close

Learning Objectives

- Describe how 3D models can enhance safety on the construction site

Safety Message: North Carolina DOT

Hello. My name is Charlie Brown. I am the State Location & Surveys Engineer for the North Carolina Department of Transportation. I have nearly 30 years of experience doing route location surveys, and am a Professional Engineer and Professional Land Surveyor in North Carolina.

We at the NCDOT have been utilizing GPS and now GNSS applications and tools since they became commercially available. Our first GPS project was in 1992; we made a major purchase of GPS equipment in 1994, and have expanded our GPS/GNSS capabilities ever since. Not only did we see the potential for GPS technology to allow us to work faster, with less traversing, but early on we saw the safety potential in this equipment.

Safety Message: North Carolina DOT

Charlie Brown NCDOT
State Location & Surveys Engineer

- NCDOT began using GPS and GNSS in 1992
- Safety enhanced through efficiency gains and no need for line-of-sight
- S*afety* factored into the decision-making on where to locate control points
- Location awareness reduces the need for stakes, keeps people out of the path of equipment
- Faster, Better, Safer

Safety Message: New York State DOT

STATE OF NEW YORK
DEPARTMENT OF TRANSPORTATION
ALBANY, N.Y. 12232
www.dot.ny.gov

March 18, 2014

Douglas Townes, P.E.
Construction Engineer
FHWA Resource Center
61 Forsyth Street, Suite 17T26
Atlanta, GA 30303

Dear Mr. Townes:

The New York State Department of Transportation (NYSDOT), Office of Construction, has supported use of 3D modeling technology since 2005 when we started leasing GPS equipment for our Construction field staff. It started slowly; originally being deployed only on major earthwork projects and included site-specific training along with support from vendors and in-house staff. With continued use, staff have become more familiar and comfortable with the equipment and technology and started using it for multiple applications and data collection purposes on these projects. Realizing the major time savings, increased accuracy and the overall safety benefits that result from the technology, compared to traditional methods, NYSDOT is requesting that GPS equipment be included beyond the major earthwork projects.

Some of the benefits expressed by our field staff have been the ability to easily and safely measure irregular areas (topsoil, seeding and mulching, sidewalks), quickly verify contractor's layout/grades (less time wasted waiting for survey support), map utility locations (both above ground and below) and create accurate As-Built plans to avoid design/utility conflicts with future projects.

Contractors have also realized their benefits from using the technology and regularly request the designer's electronic engineered data (EED) for use with their Automated Machine Guidance (AMG) systems. Now, they have the ability to complete large volumes of earthwork, excavation and roadway grading operations more accurately and in a reduced timeframe. This creates savings by reducing work operation hours for personnel and machines and reduces equipment fuel consumption by reducing machine idle time and number of passes to accomplish the desired results. Our Department then started using 3D models and GPS equipment on more work operations to verify layout, collect quantities, locate features, grades and surfaces for contract payments. Eventually, the data collected is used to create an electronic As-Built record plan.

NYSDOT has realized multiple benefits from the use of 3D models on our projects including: time savings and safety while collecting the data, improved accuracy of the data collected and eventually cost savings to the contractors. An added bonus has been reducing the amount of disputed work on projects by resolving many discrepancies at the project level, avoiding potential litigation or time delay claims.

All of these components together create a safer work environment for the project and contractor's staff, has the potential to deliver a more accurate product and results in beneficial savings to the contractors that we feel will eventually, result in lower bid prices for our projects.

Very truly yours,

P.E.

James F. Tynan, P.E.
Director, Office of Construction

JFT:JL:maf

cc: D. D'Angelo, FHWA Every Day Counts Lead Coordinator
C. Boyle, Region 11 Construction
J. King, Office of Construction
B. Dean, Office of Construction

Safety Message: New York State DOT

James Tynan, PE NYSDOT
Director, Office of Construction

- Supported the use of 3D Modeling since 2005
- Leased GPS equipment initially only for major earthworks projects
- Now used for multiple applications and data collection, with time savings, increased accuracy and *<u>overall safety benefits</u>*
- Easily and safely measure irregular areas, quickly verify layout and grades, map utility locations, create as-builts
- Added bonus: resolve discrepancies at the project level results in *<u>less disputed work, avoiding claims and litigation</u>*

Verify Learning Outcomes

- Describe how 3D models can enhance safety on the construction site

Supporting 3D/4D Construction Applications in Preconstruction

Lance Parve, PG

Wisconsin Department of Transportation

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U.S. Department of Transportation

Federal Highway Administration

Learning Objectives

- Describe applications and support activities using 3D and 4D models for construction
- Discuss construction site survey requirements for using 3D models
- Describe ways an owner can use 3D models to reduce risk of change orders, delays and claims

3D Construction Applications in the Design-Construction Process

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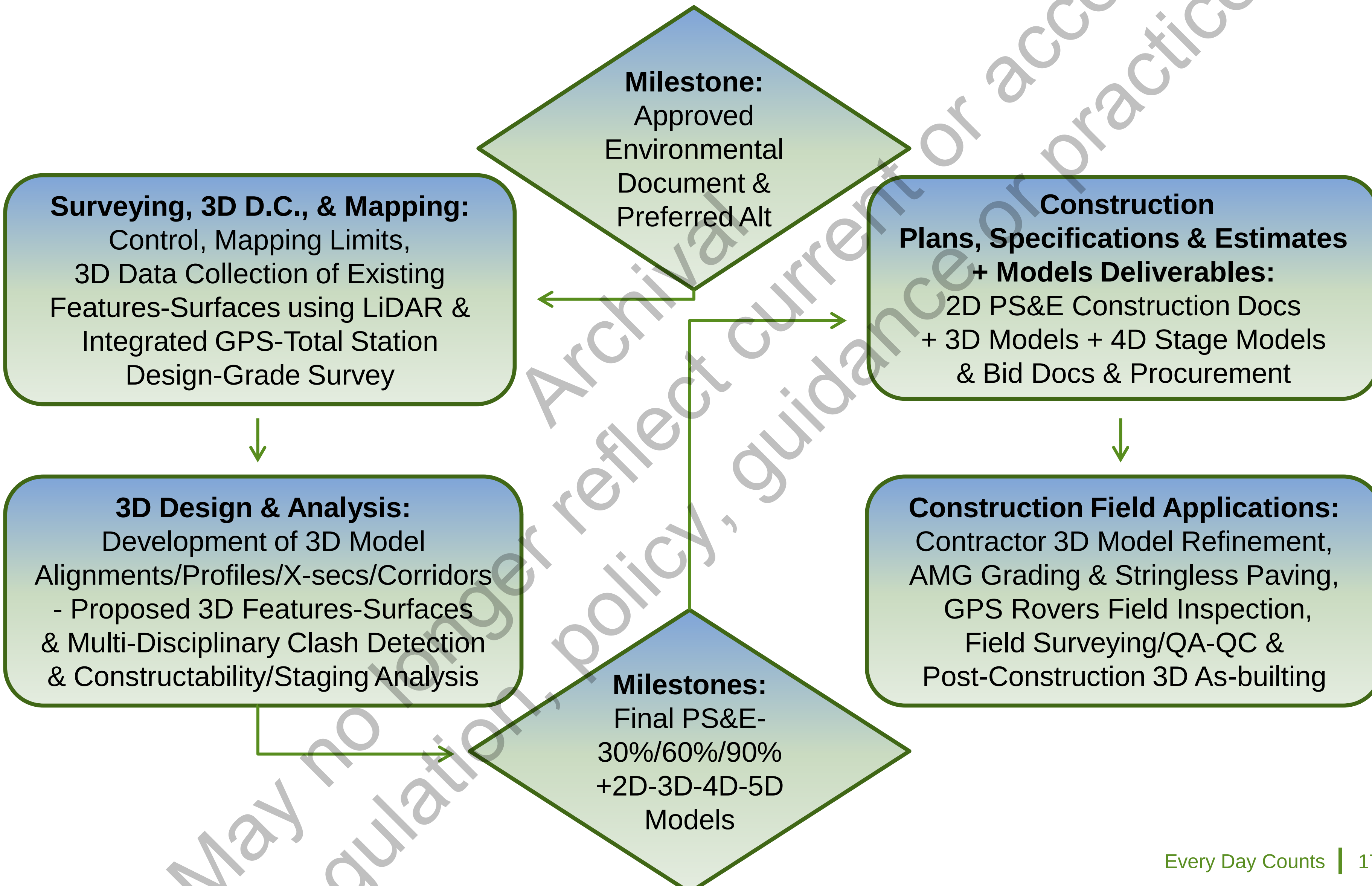
Transportation Facilities Design-Construction 3D Engineered Modeling Workflow



Transportation Facilities Design-Construction & 3D Engineered Modeling

Planning & Survey & Mapping | Environmental Study & Preferred Alternative | Design | Bidding & Procurement | Construction | Maintenance & Operations

- Program-Project Initiation
- Highway Needs-Pr
- Data Collection
- 3D Survey & Data I of LiDAR, GPS, TS
- 3D CAD DTMs & F
- 3D Existing Model
- Funding-Finance

- Public Involvement
- Environmental Imp
- 3D Existing Model
- Feasibility Analysis
- Alternatives Analys
- Preferred Alternativ
- CSD/CSS
- Public Support

- 30% / 60% Prelim Design
- 90% / Final Design-M
- Plans, Specs & Estir
- Roadways, Pavemen Structures, Traffic, U Real Estate, Geotecl
- Clash Detection-Res
- Simulation & Analysi
- Constructability Anal

- PS&E & 3D/4D Models
- Bid Docs & Adverti
- Construction Bid
- Prebuild Model + R
- GC + Subcontracto
- Shop Drawings
- Digital Prototyping
- Materials Procurem
- QA/QC Manageme

- PS&E & 3D Models
- 4D Staging Models
- Scheduling / Costs
- Construction Revie
- AMG, SL Paving
- Rovers & Inspectio
- RFIs, DINs, CCOs
- Quantity Pay Items
- As-builts Data Colle

- 3D As-built Models + GIS
- Asset Management
- Pavement Managment
- Structures Management
- Life Cycle Management
- Facilities Maintenance
- Traffic Operations
- Monitoring
- RRR Program

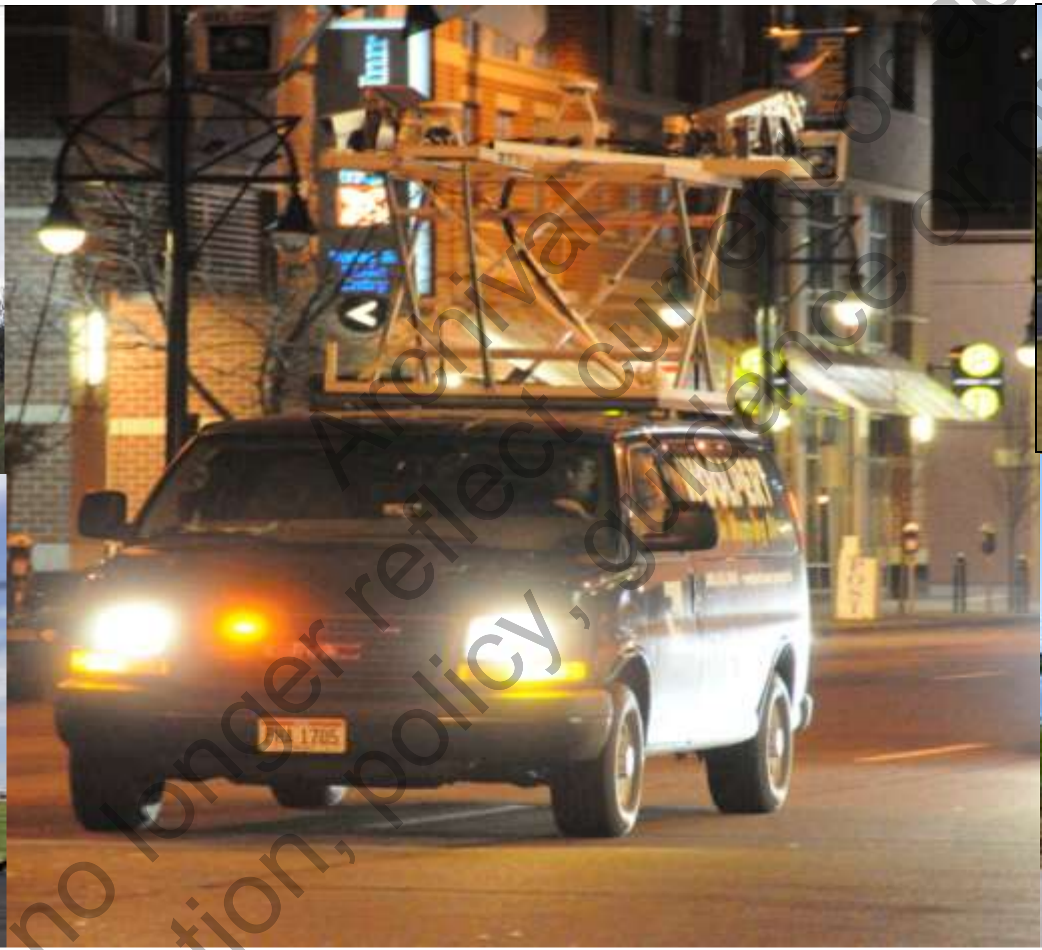
Civil Integrated Modeling Virtual Design-Construction Process for Transportation Infrastructure Facilities
Collaboration Shared Database Information Management Model throughout the entire project life cycle

Poll Pod: Equipment for QA & Measurement

What equipment do you use on site for QA and Measurement?

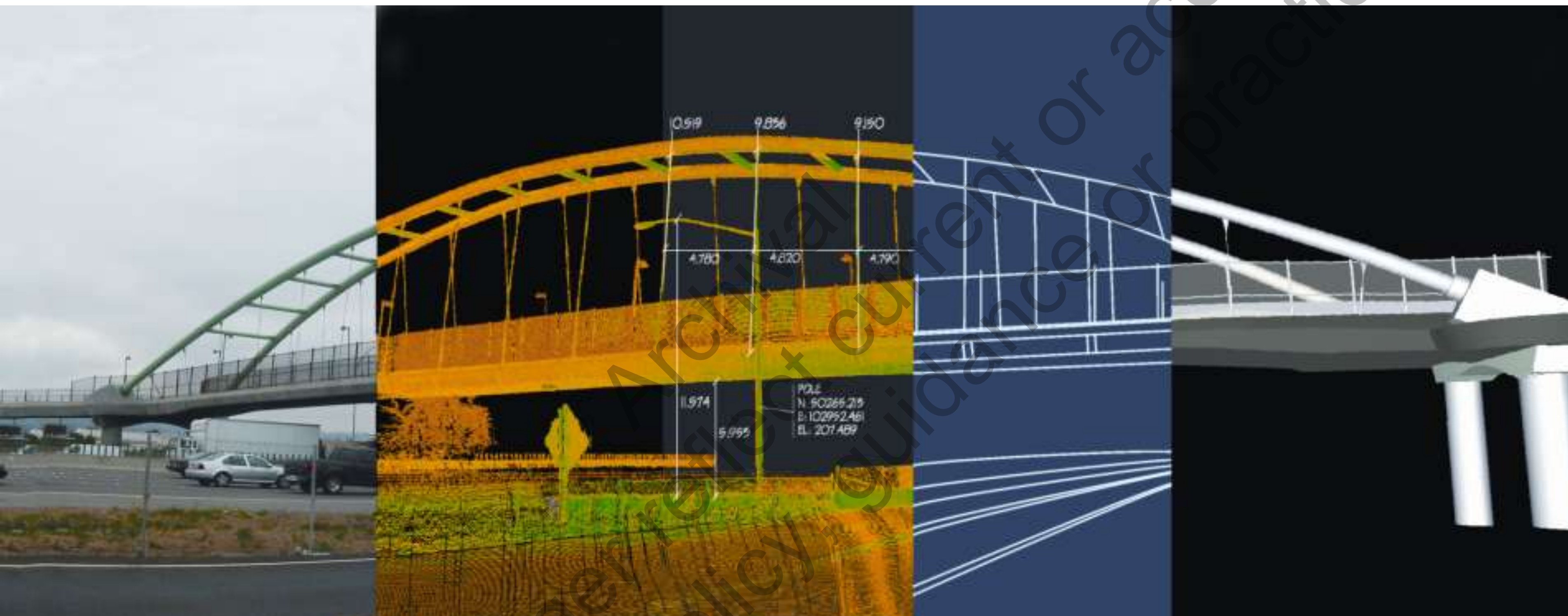
- GPS/GNSS Rovers
- Robotic Total Stations
- Digital Levels
- Static LiDAR
- Mobile LiDAR
- Traditional Total Stations
- Traditional Levels
- Stakes
- Hubs and Strings/Wires
- Straight Edges
- Measuring Wheels
- Wireless Data Collectors/Tablets
- Pen and Paper

Surveying, 3D Data Collection, & Mapping



Surveying, 3D Data Collection, & Mapping

Surveying, 3D Data Collection, & Mapping

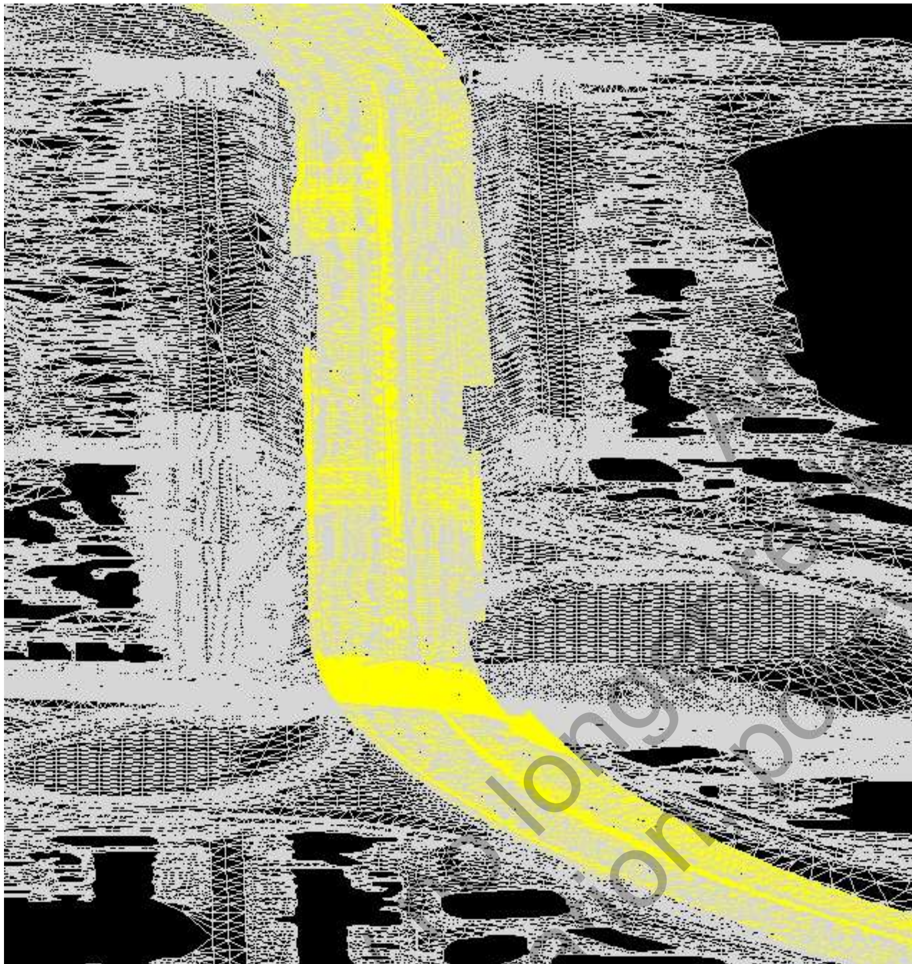


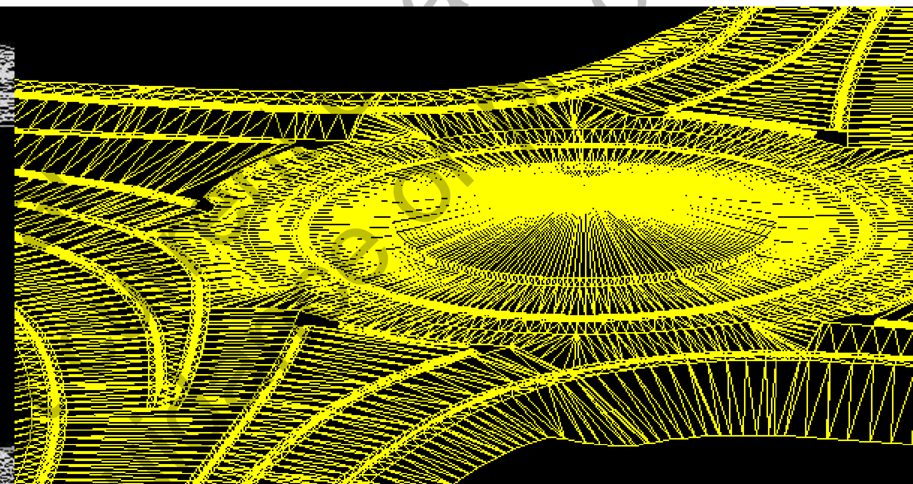
Georeferenced	**3D XYZ**	**3D**	**3D**
Hi-res Digital	**LAS Point Clouds**	**Feature Lines**	**Features**
Images	**Fused Survey Data**	**TINs**	**DTMs**

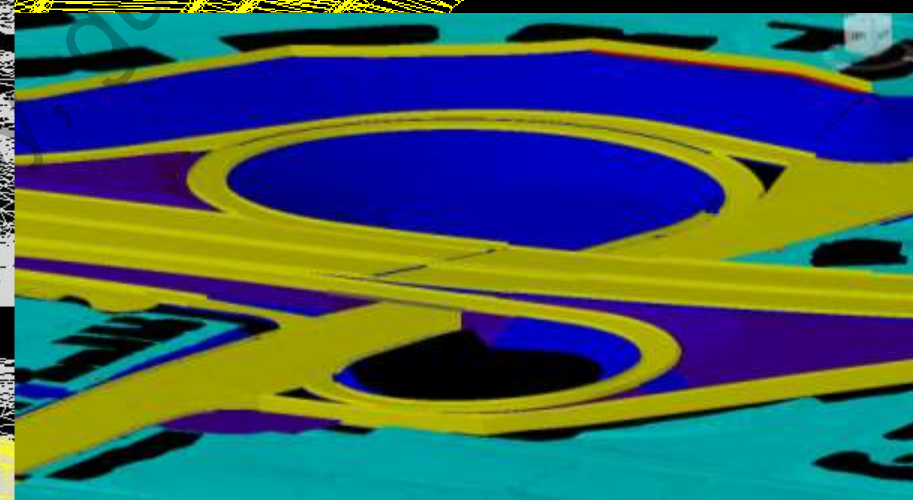
Surveying, 3D Data Collection, & Mapping

- **Fixed Wing Aerial LiDAR/Photogrammetry**
  ± 3”- 6” Vertical Accuracy (Low and Slow)
- **Low Altitude Helicopter LiDAR/Photogrammetry**
  ± 1”-2” Vertical Accuracy
- **Terrestrial Surveying GPS-HATs/Supplemental**
  ± ½” – 1” Vertical Accuracy
- **Mobile LiDAR Mapping System**
  ± ½”-1” Vertical Accuracy
- **Tripod-Mounted Static LiDAR Mapping System**
  ± ¼” - ½” Vertical Accuracy
- **Terrestrial Surveying TS/Leveling-Check Sections**
  < ± ¼” - ½” Vertical Accuracy

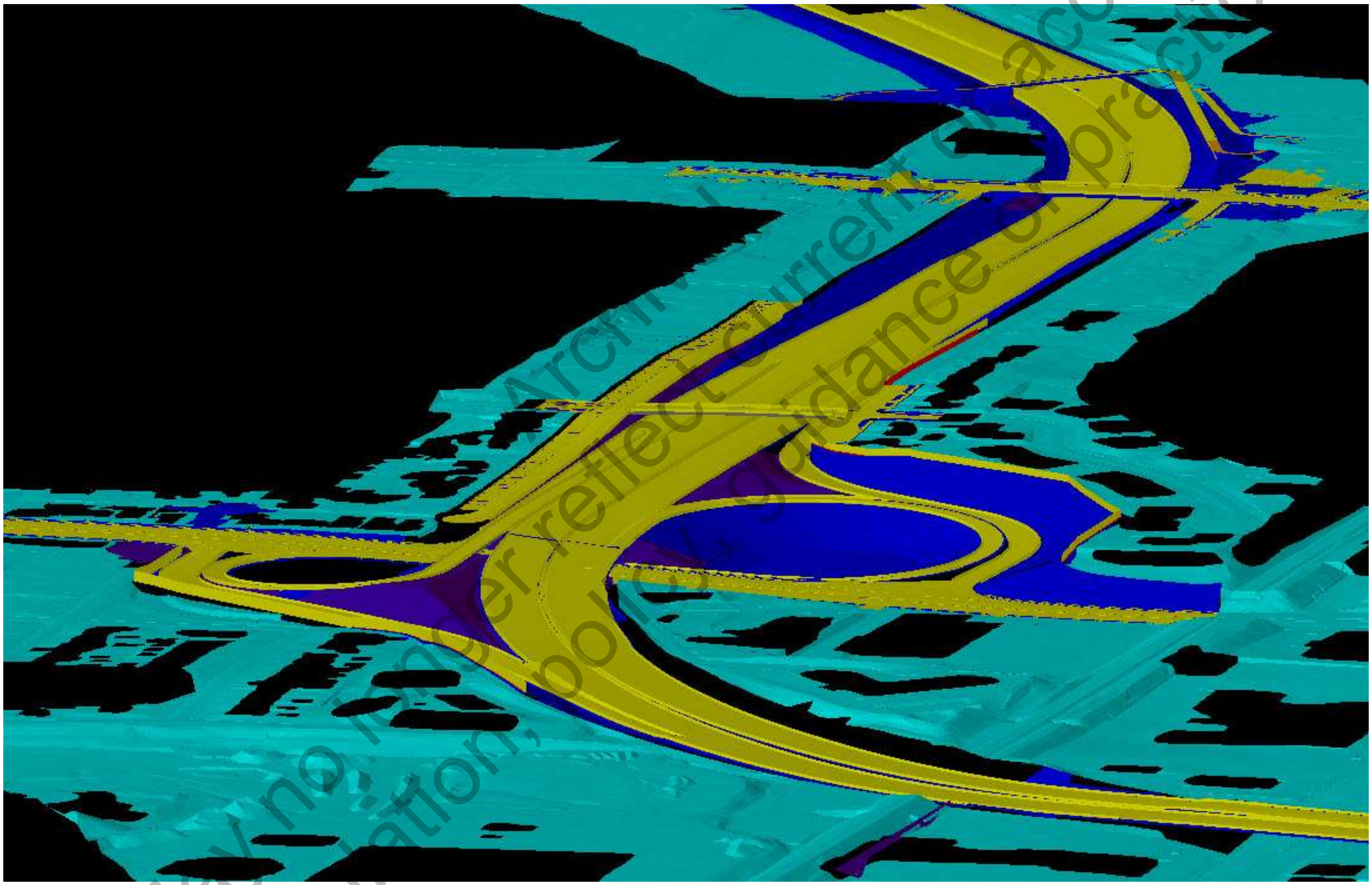
3D Design & Analysis







3D Design & Analysis



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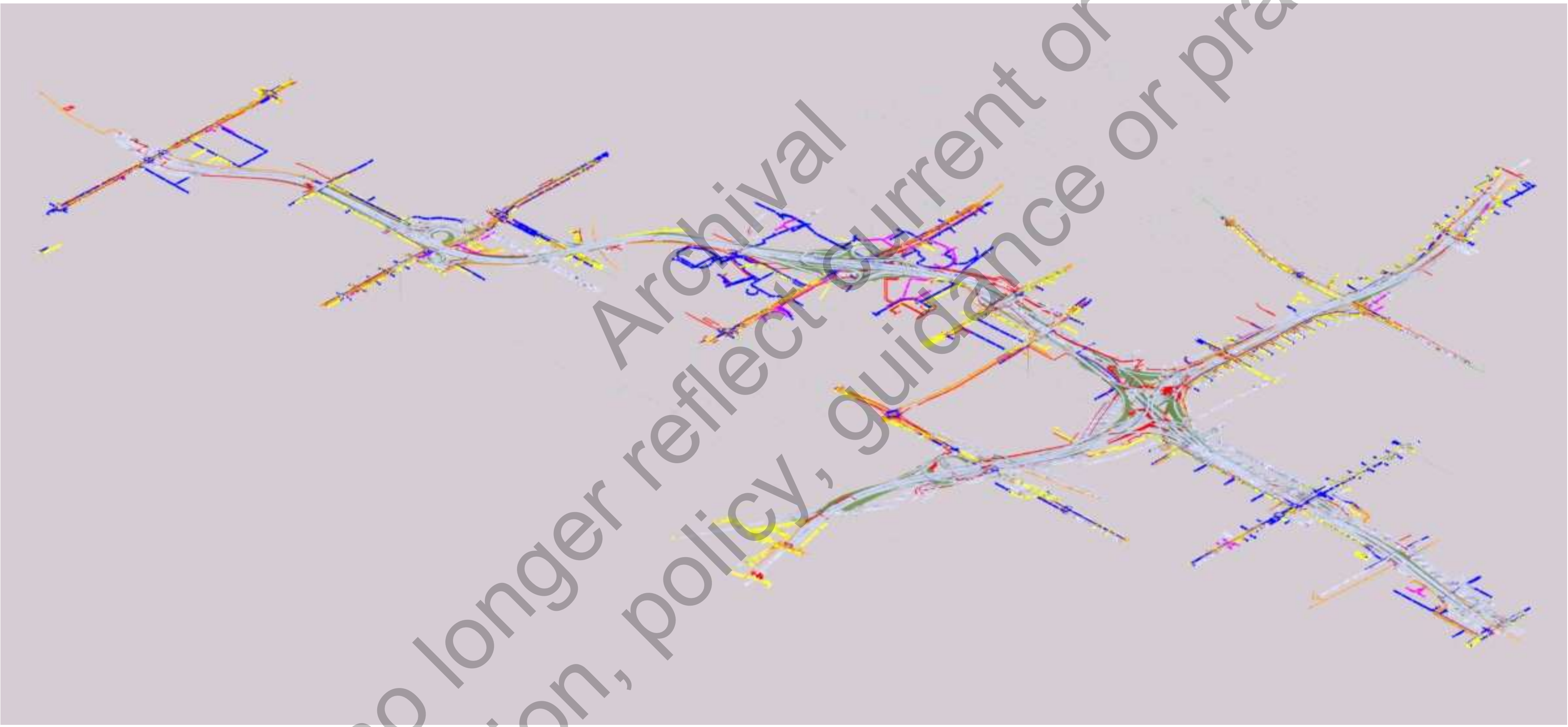

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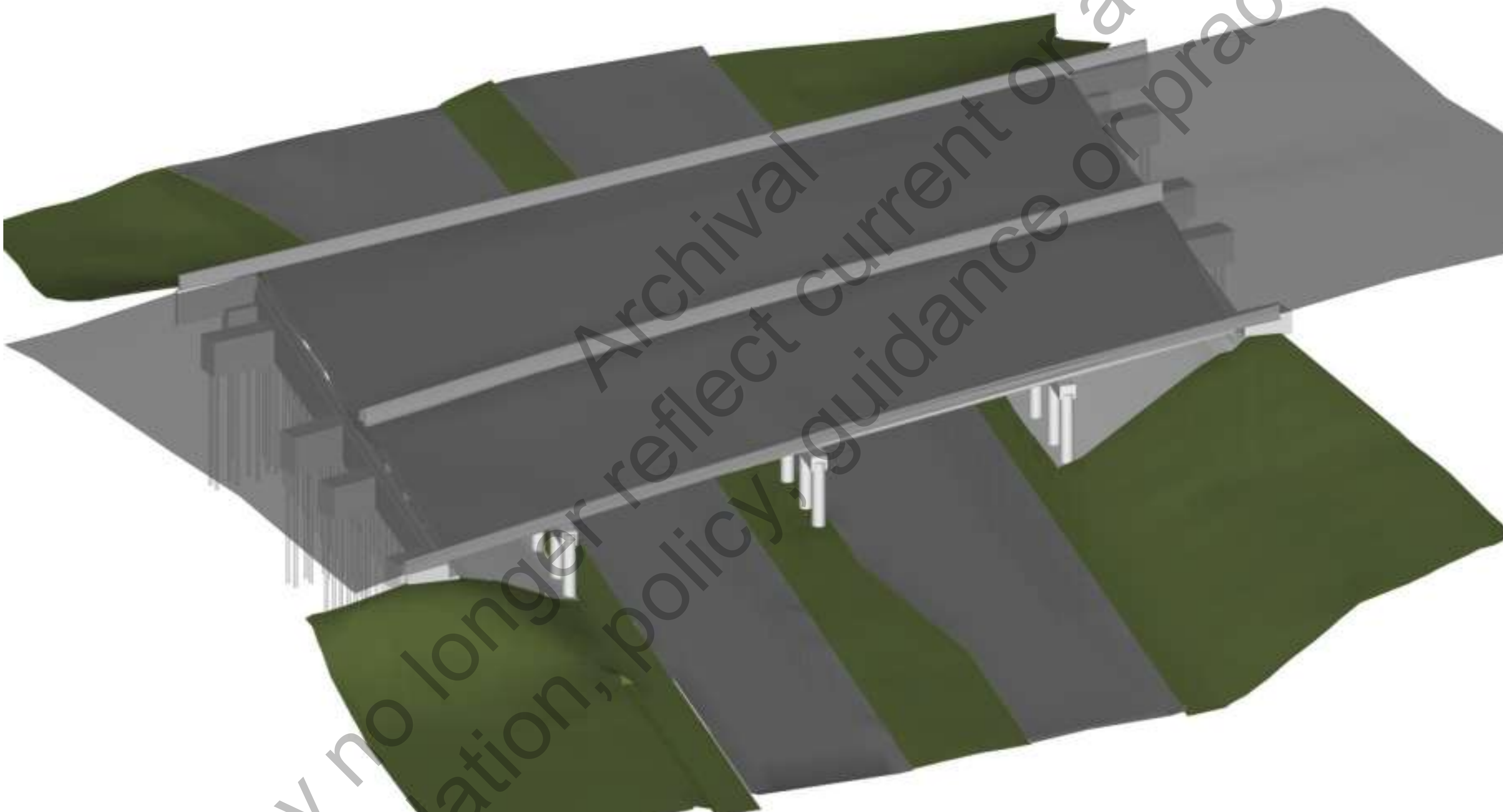

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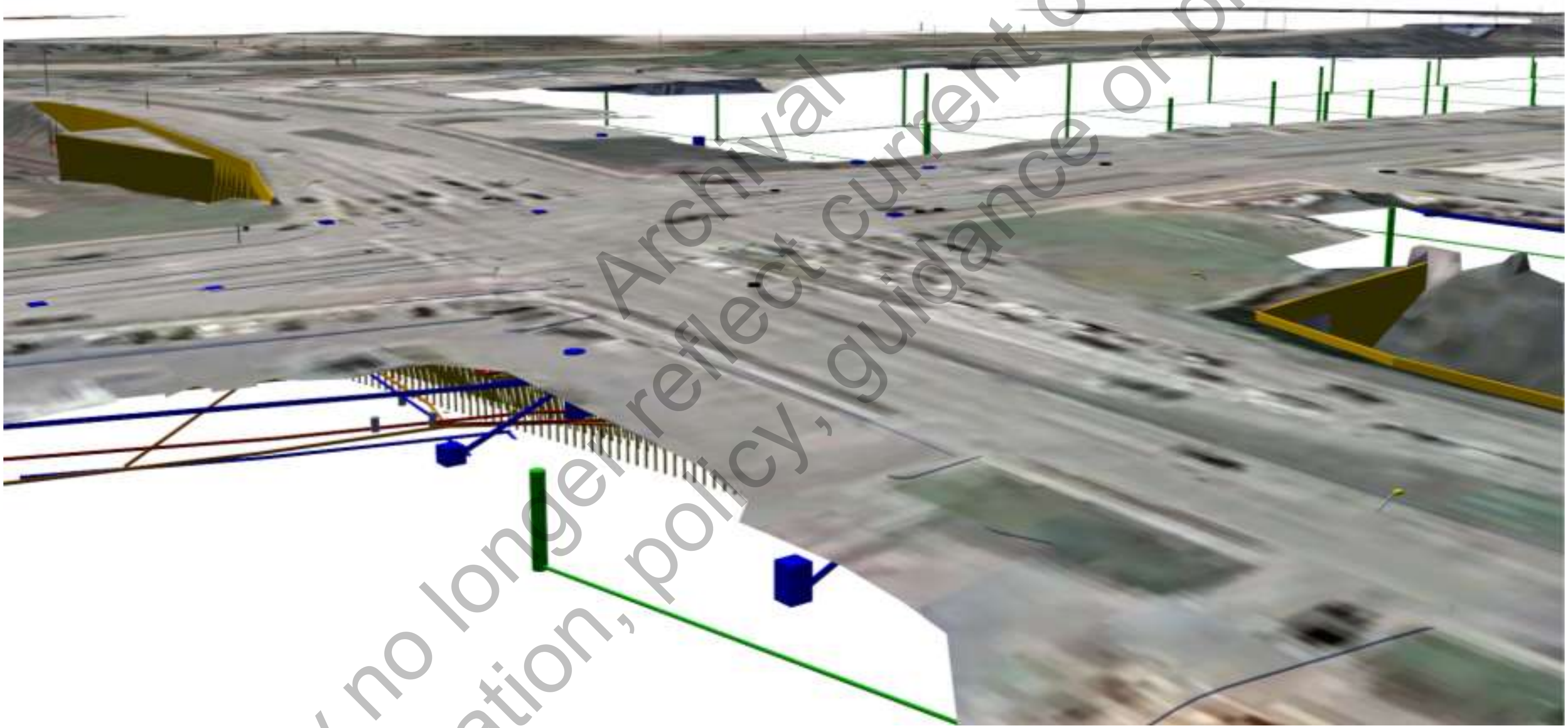

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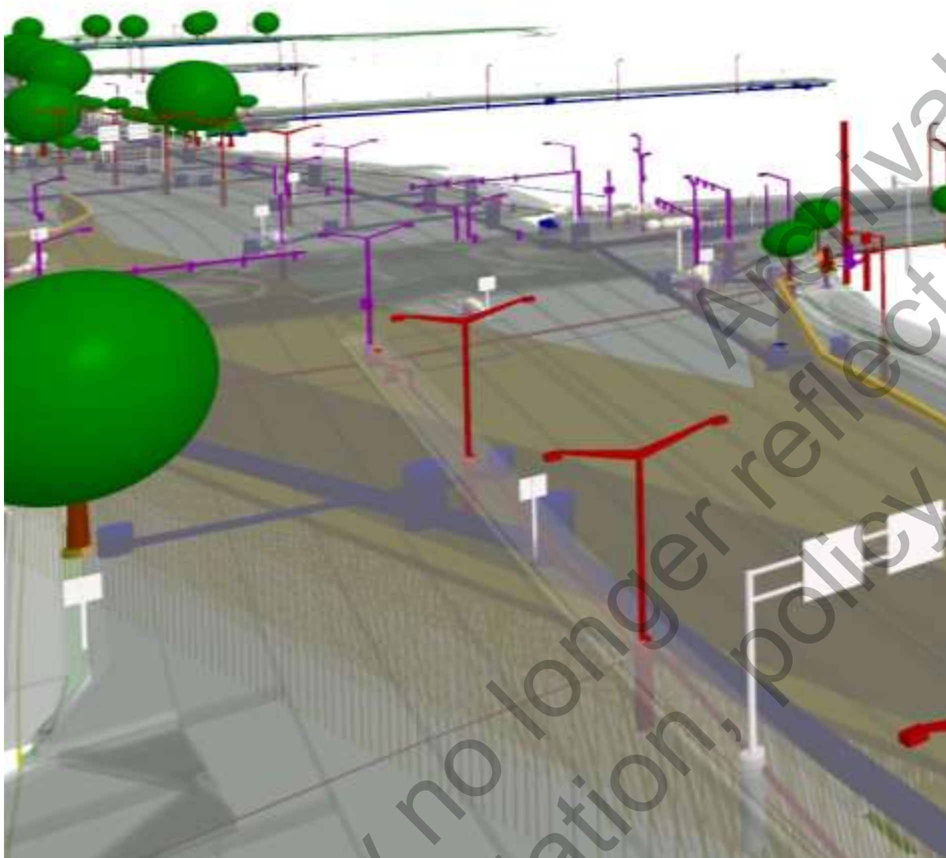

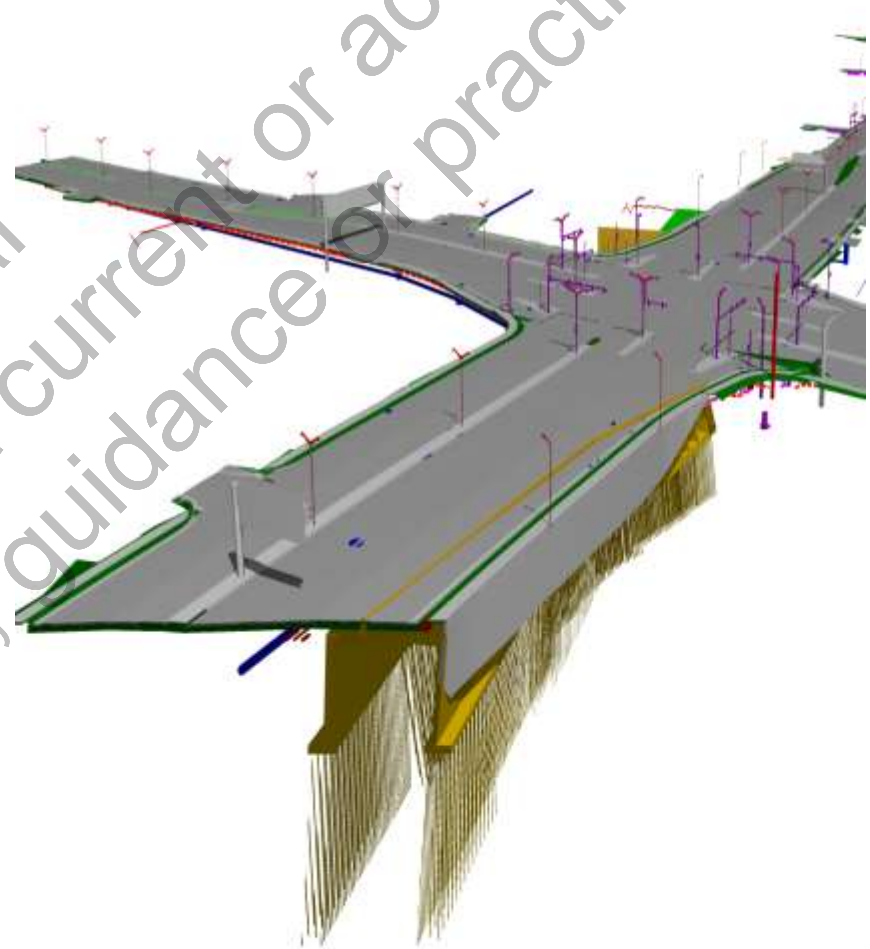

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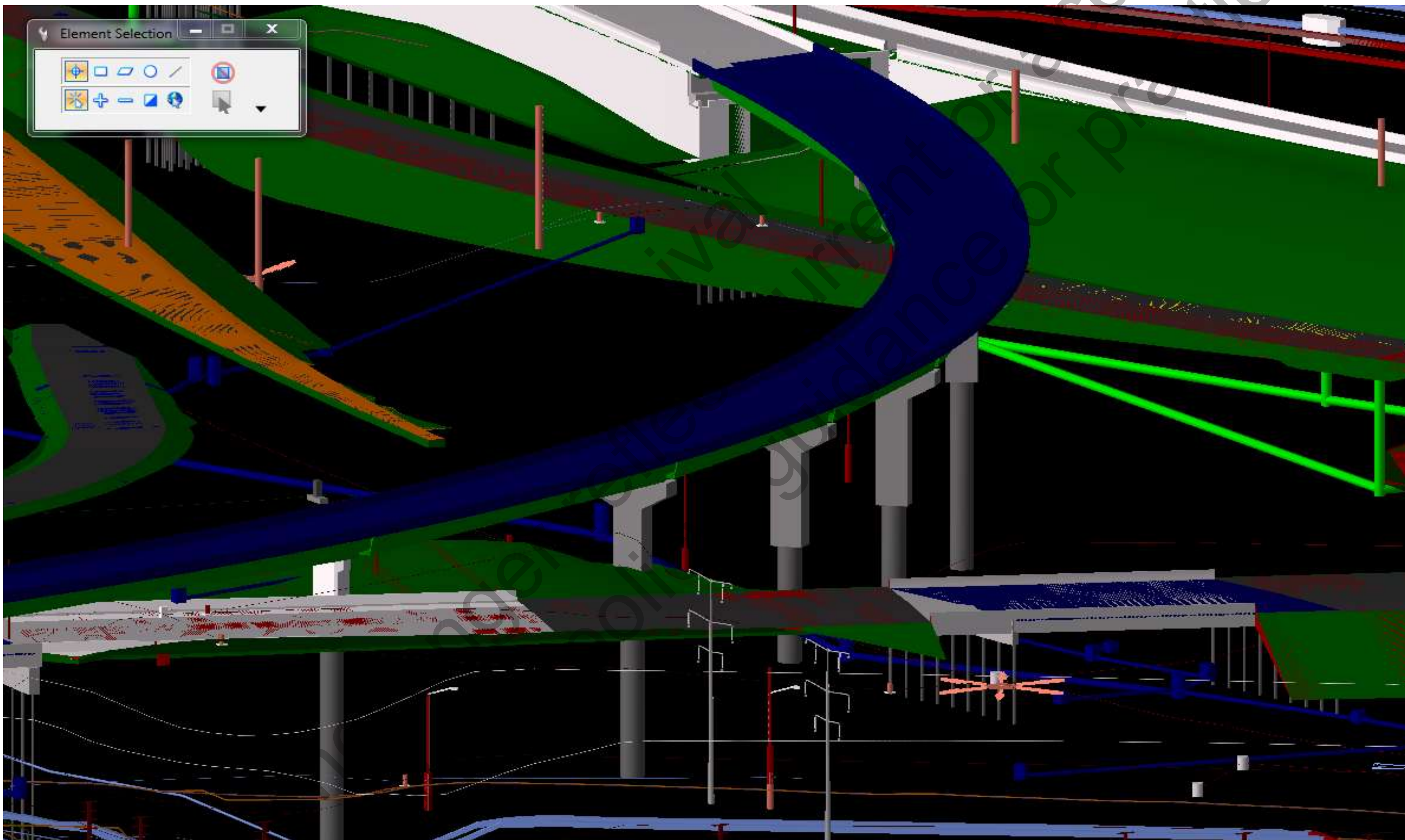

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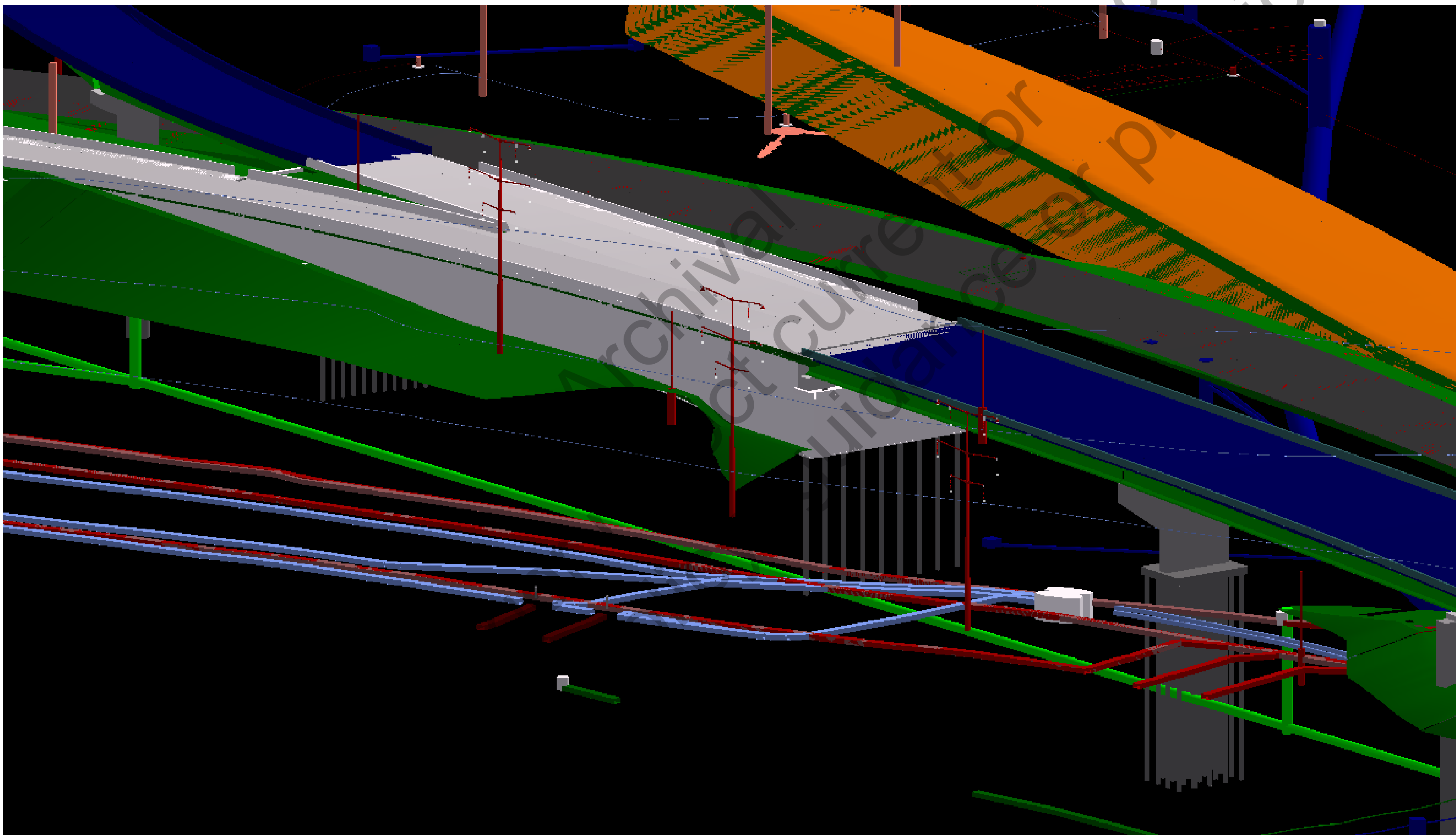

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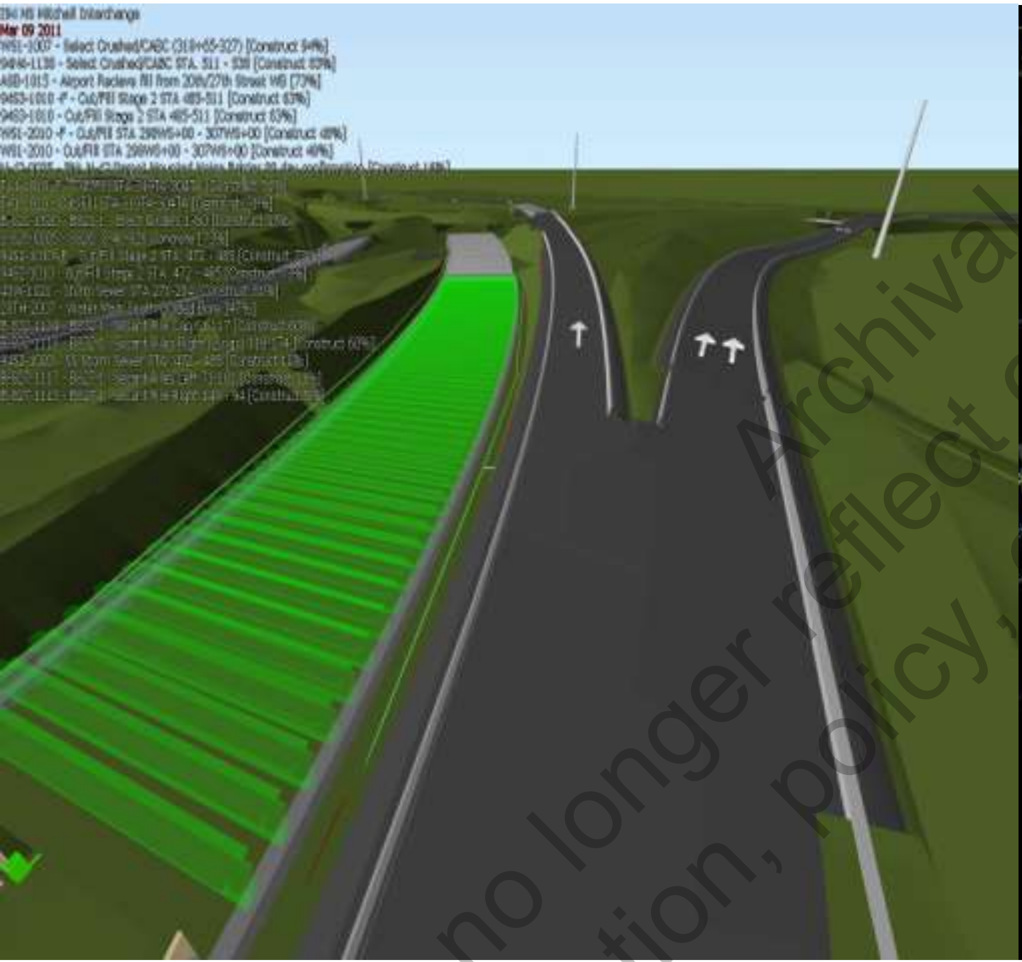

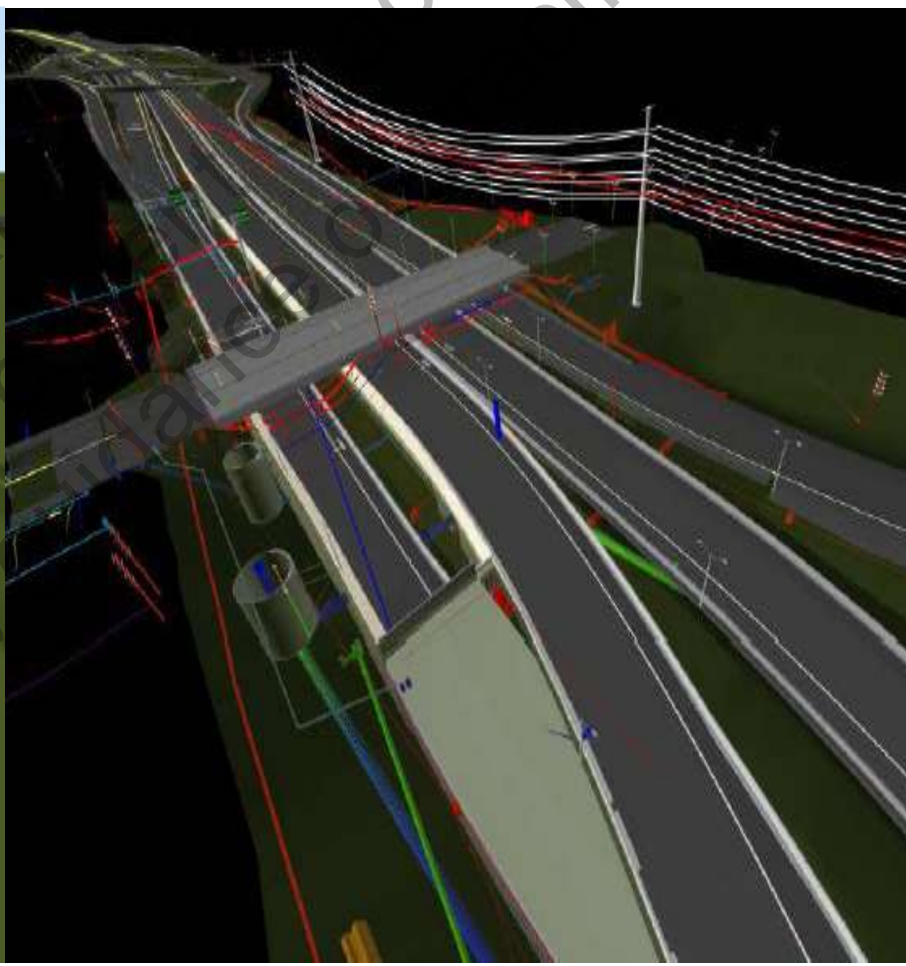

3D/4D Applications and Support Activities in for Construction

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Poll Pod: 4D Modeling

Who uses 4D Modeling on your projects?

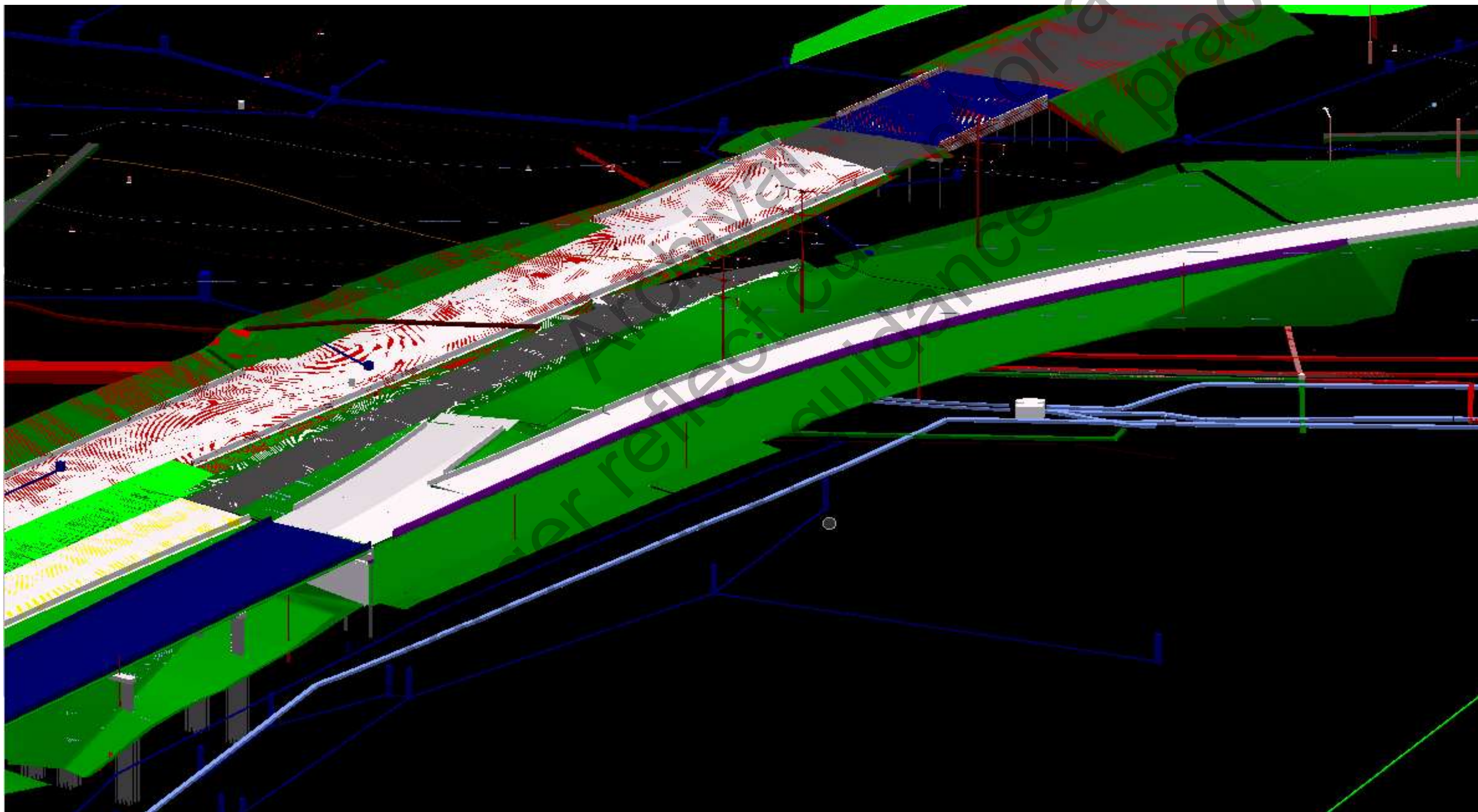
- Designer
- Contractor
- Engineer
- Program Manager
- No 4D Modeling used

3D Engineered Model Delivery for Construction
3D/4D Applications & Support Activities

- Benefits of 3D/4D Models for Construction
- Design Model to be provided to Bidders at Advertisement
- Bidders prebuild Model from PS&E and refine Model
- RFIs and CRIs are submitted by Bidders
- Project Modeling Matrix (PMM)
- Project Execution Plan (PXP)
- Construction Review of Model
- Construction Applications and Trends

Construction Review & Constructabilty Analysis

Reduced CCOs, RFIs and DINs



Benefits of 3D/4D Models for Construction

- Visualization of PS&Es
- Integrate and aggregate readily multi-disciplinary data
- Design, visualize, analyze, optimize and simulate project "virtually" digitally in office before constructing in the field
- Find/fix conflicts earlier in process with Clash-Gap Detection
- Reduce CCOs, DINs, project risk, re-work, cost and schedule
- Cost Avoidance/Cost Savings during Construction
- Increase Communication, Coordination, and Collaboration
- Design Model to be provided to Bidders at Advertisement
- Use of AMG/AMC and Stringless/Wireless Paving
- Reduce field inspection labor w/Tablet PCs/Rovers QA/QC
- Enhance Construction Site with WiFi and UAS/UAVs

Construction Requirements for Using 3D/4D Engineered Models

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3D Engineered Model Delivery
Project Modeling Matrix & Project Execution Plan

- What is in & not in the Model (Model Content) for Construction?
- Will the Model include PS&E, Addendums, & Plan Revisions?
- Will the Model include Utilities & Geotech info?
- What formats (CAD, XML, GIS) will the Model be in?
- What is the Model's geospatial info (Coordinate System, Projection, & Level of Accuracy-LOA)?
- What is the Level of Development-LOD (2D, 3D, 4D, 5D, nD)?
- Will Staged, Temporary Construction & 4D Models be included?

3D Engineered Model Delivery
Project Modeling Matrix & Project Execution Plan

- Will and when will Model & Staged Models be delivered?
- Will 4D project scheduling be integrated with Model?
- Will file, format, & version conversions be required?
- Will xyz coordinate translation, rotation, & scaling be required?
- How are project standards and protocols maintained?
- How and who will update the Model?
- How is project data transferred and archived?
- How will the Model be reviewed, validated, & QA/QC'ed?
- How is a Common Data Environment (CDE) handled for Survey for Construction?

3D Engineered Model Delivery
Project Modeling Matrix & Project Execution Plan

ELEMENT	FORMAT	LOA-CD	LOD-CD	TEMPORARY	BY STAGE
R/W and Environmental Areas					
R/W-Proposed	DGN/DWG	0.01’	2D	N/A	N/A
Easements-Proposed	DGN/DWG	0.01’	2D	N/A	N/A
Fences-Proposed	DGN/DWG	<0.06’	2D	2D	N/A
Wetlands-Located/Surveyed-Existing	DGN/DWG	<0.06’	2D	N/A	N/A
Non-roadway Surfaces					
Surfaces-Existing	DGN/DWG/XML	<0.06’	3D	N/A	N/A
Grading/Non-roadway Surfaces-Proposed	DGN/DWG/XML	<0.06’	3D	3D	Yes
Cut/Fill Areas-Isopachs-Proposed	DGN/DWG	<0.06’	2D	N/A	N/A
Longitudinal Breaklines /Surface Points	DGN/DWG	<0.06’	3D	N/A	N/A
Slope Intercepts/Surface Limits	DGN/DWG	<0.06’	2D	N/A	N/A
Roadways/Roadway Features Surfaces-Proposed					
Roadway Pavement-Top Surfaces-Proposed	DGN/DWG/XML	<0.02’	3D	3D	Yes
Roadway Pavement-Base Course Surfaces-Proposed	DGN/DWG/XML	<0.06’	3D	3D	Yes
Roadway Pavement-Subgrade Datum Surfaces-Proposed	DGN/DWG/XML	<0.06’	3D	3D	Yes
Roadway Curb and Gutter -Proposed	DGN/DWG/XML	<0.02’	3D	3D	Yes
Roadway Barriers -Proposed	DGN/DWG/XML	<0.06’	3D	3D	Yes
Roadway Pavement Marking -Existing	DGN/DWG	<0.10’	2D	N/A	N/A
Roadway Pavement Marking-Proposed	DGN/DWG	<0.10’	2D	2D	Yes
Roadway Stationing-Proposed	DGN/DWG	0.01’	2D	N/A	N/A
Roadway Alignments /Reference Lines-Proposed	DGN/DWG	0.01’	2D	N/A	N/A
Superelevation Transition Stations-Proposed	CSV	0.01’	N/A	N/A	N/A
Drainage-Storm Sewer - Proposed					
Drainage Inlets/MHs/Outfalls/ Pipes/Culverts/Ponds	DGN/DWG	<0.06’	3D	3D	Yes

3D Engineered Model Delivery
Project Modeling Matrix & Project Execution Plan

Bridges-Proposed					
Stone Base	DGN/DWG/XML	<0.06’	3D	3D	Yes
Pile	DGN/DWG/XML	<0.06’	3D	3D	Yes
Footing	DGN/DWG/XML	<0.06’	3D	3D	Yes
Abutments	DGN/DWG/XML	<0.06’	3D	3D	Yes
Piers	DGN/DWG/XML	<0.02’	3D	3D	Yes
CI Beams	DGN/DWG/XML	<0.02’	3D	3D	Yes
Seats	DGN/DWG/XML	<0.02’	3D	3D	Yes
Deck Including Fillets	DGN/DWG/XML	<0.02’	3D	3D	Yes
Light Blisters	DGN/DWG/XML	<0.06’	3D	3D	Yes
Parapet Walls	DGN/DWG/XML	<0.06’	3D	N/A	N/A
Retaining Walls-Proposed					
MSE-Proposed					
Straps	DGN/DWG/XML	<0.06’	3D	3D	Yes
Footing	DGN/DWG/XML	<0.06’	3D	3D	Yes
Top	DGN/DWG/XML	<0.06’	3D	3D	Yes
Coping	DGN/DWG/XML	<0.06’	3D	3D	Yes
Cast-in-Place-Proposed					
Stone	DGN/DWG/XML	<0.06’	3D	3D	Yes
Pile	DGN/DWG/XML	<0.06’	3D	3D	Yes
Top of Footing	DGN/DWG/XML	<0.06’	3D	3D	Yes
Face of Wall	DGN/DWG/XML	<0.06’	3D	3D	Yes
Coping	DGN/DWG/XML	<0.06’	3D	3D	Yes

3D Engineered Model Delivery
Project Modeling Matrix & Project Execution Plan

Pile and Lagging-Proposed					
CI Pile at Top and Bottom	DGN/DWG/XML	<0.06’	3D	3D	Yes
Face of Wall/Face of Pile	DGN/DWG/XML	<0.06’	3D	3D	Yes
Bottom of Wall	DGN/DWG/XML	<0.06’	3D	3D	Yes
Top of Wall/Coping	DGN/DWG/XML	<0.06’	3D	3D	Yes
Face of Pile	DGN/DWG/XML	<0.06’	3D	3D	Yes
Top and Toe of Sheets	DGN/DWG/XML	<0.06’	3D	3D	Yes
Sign Bridges-Proposed					
Footing	DGN/DWG/XML	<0.06’	3D	N/A	N/A
Pile	DGN/DWG/XML	<0.06’	3D	N/A	N/A
Structure	DGN/DWG/XML	<0.06’	3D	N/A	N/A
Other Structures-Proposed					
Noise Walls	DGN/DWG/XML	<0.06’	3D	N/A	N/A
Screening Fence	DGN/DWG/XML	<0.06’	3D	N/A	N/A
Tunnel-Utility	DGN/DWG/XML	<0.06’	3D	N/A	N/A
Special Foundations-Proposed					
Drilled Shafts	DGN/DWG/XML	<0.06’	3D	3D	Yes
Driven Piles	DGN/DWG/XML	<0.06’	3D	3D	Yes
Bored Piles	DGN/DWG/XML	<0.06’	3D	3D	Yes
Caissons	DGN/DWG/XML	<0.06’	3D	3D	Yes

3D Engineered Model Delivery
Project Modeling Matrix & Project Execution Plan

Special Foundation Walls-Proposed					
Foundation Anchors	DGN/DWG/XML	<0.06’	3D	3D	Yes
Underpinning	DGN/DWG/XML	<0.06’	3D	3D	Yes
Pile Caps	DGN/DWG/XML	<0.06’	3D	3D	Yes
Grade Beams	DGN/DWG/XML	<0.06’	3D	3D	Yes
Tiebacks	DGN/DWG/XML	<0.06’	3D	3D	Yes
Lighting-Proposed					
Poles/Masts/Bases	DGN/DWG	<0.06’	3D	3D	Yes
Conduit/Pull Boxes	DGN/DWG	<0.06’	3D	3D	Yes
FTMS-Proposed					
DMS/CMS	DGN/DWG	<0.06’	2D	N/A	N/A
FTMS Fiber Optic lines	DGN/DWG	<0.06’	3D	N/A	N/A
FTMS Huts/Cabinets	DGN/DWG	<0.06’	2D	N/A	N/A
Signs-Proposed					
Signs-Type 1	DGN/DWG	<0.06’	2D	2D	Yes
Signs-Type 2	DGN/DWG	<0.06’	2D	2D	Yes
Traffic Signals-Proposed					
Poles/Heads/Bases	DGN/DWG	<0.06’	3D	3D	Yes
Conduit/Pull Boxes	DGN/DWG	<0.06’	3D	3D	Yes
Water Main Proposed					
Pipes	DGN/DWG	<0.06’	3D	N/A	N/A
Hydrants/Valves/Fittings/ Standpipes	DGN/DWG	<0.06’	3D	N/A	N/A
Sanitary Sewer-Proposed					
Pipes	DGN/DWG	<0.06’	3D	N/A	N/A
Manholes	DGN/DWG	<0.06’	3D	N/A	N/A

3D Engineered Model Delivery
Project Modeling Matrix & Project Execution Plan

Utilities - Existing/Relocated/Abandoned *					
Drainage/Storm Sewer	DGN/DWG	<0.10’ *	3D	N/A	N/A
Water Main	DGN/DWG	<0.10’ *	3D	N/A	N/A
Sanitary Sewer	DGN/DWG	<0.10’ *	3D	N/A	N/A
Lighting	DGN/DWG	<1.5’ *	2D	N/A	N/A
FTMS	DGN/DWG	<1.5’ *	2D	N/A	N/A
Traffic Control	DGN/DWG	<1.5’ *	2D	N/A	N/A

Other Utilities - Existing/Relocated/Abandoned *					
Gas	DGN/DWG	<1.5’ *	2D	N/A	N/A
Steam	DGN/DWG	<1.5’ *	2D	N/A	N/A
Electrical	DGN/DWG	<1.5’ *	2D	N/A	N/A
Communications	DGN/DWG	<1.5’ *	2D	N/A	N/A
Fiber Optic	DGN/DWG	<1.5’ *	2D	N/A	N/A
Telephone/Data	DGN/DWG	<1.5’ *	2D	N/A	N/A
CATV/Data	DGN/DWG	<1.5’ *	2D	N/A	N/A

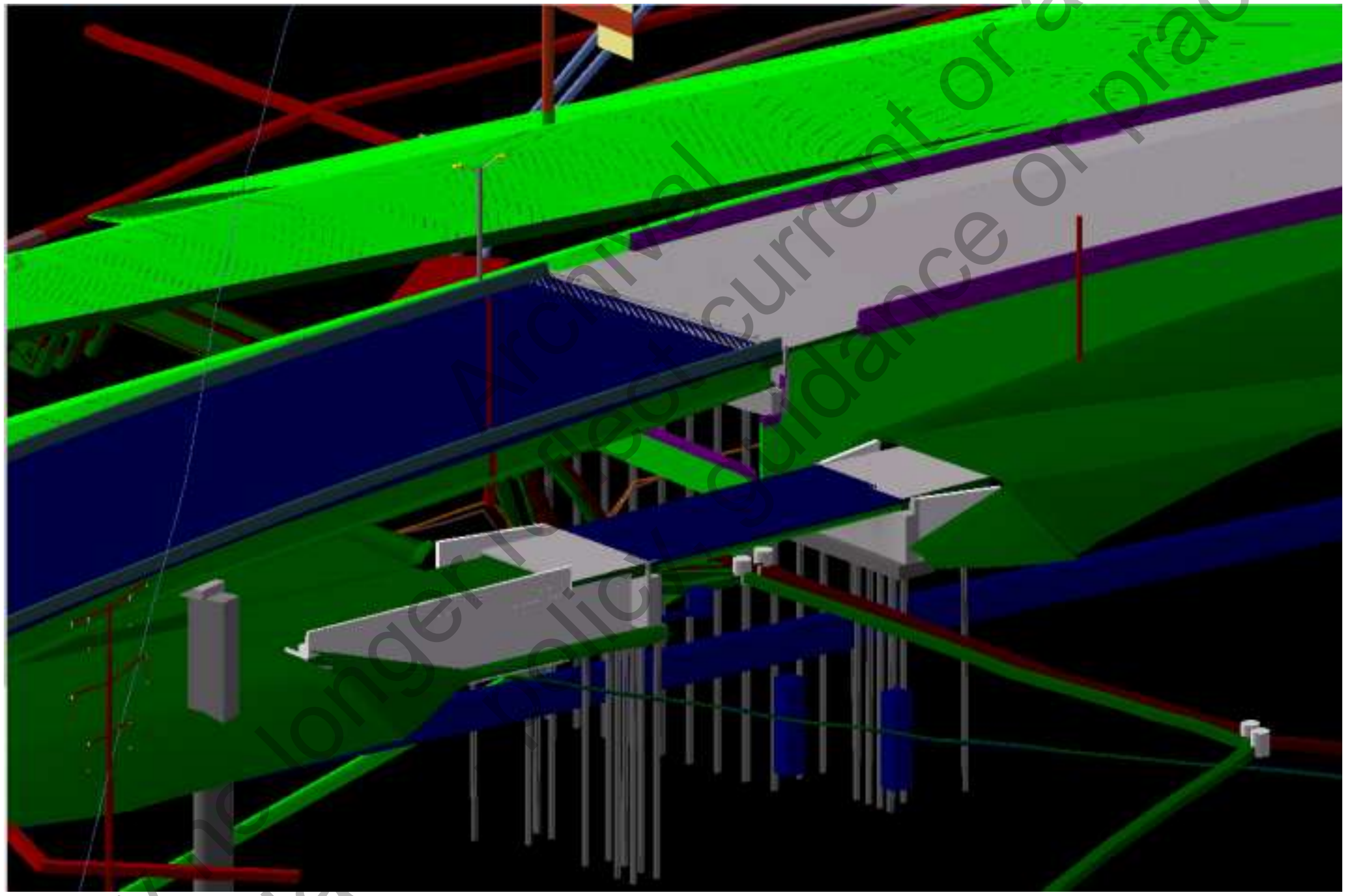
*2D and 3D existing/proposed/abandoned utilities are approximate and other utilities may not be shown.

2D and 3D existing/proposed/abandoned utilities are generated from a variety of sources and formats including:

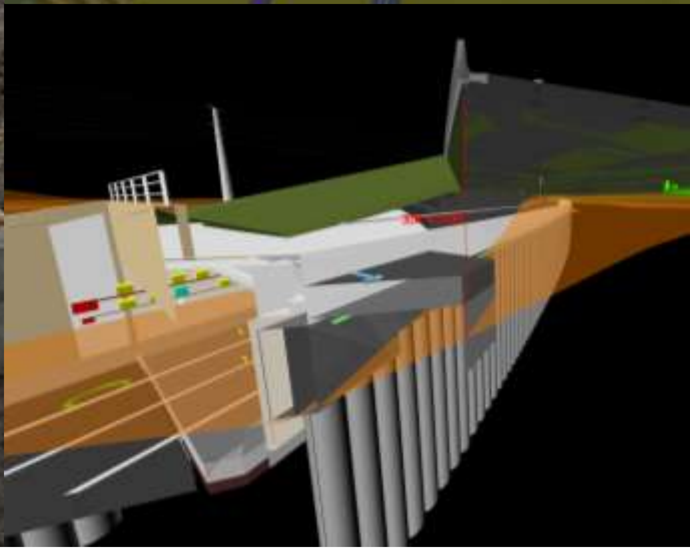
from plans with line and grade, from plans without line and grade, from surveys, from Digger’s Hotlining, from as-builts, from municipality records, from pot holing,/hydrovac, and from RD/EMI/GPR/SPAR and are provided in the model, for purposes of information only, requiring confirmation from Digger’s Hotline and Utility Providers.

Construction Review & Constructabilty Analysis

Reduced CCOs, RFIs and DINs



Construction Issues & Builder's Risk Claims



Construction Applications Using 3D/4D Models, Mobile Devices Rovers & UAS/UAVs

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Federal Highway Administration

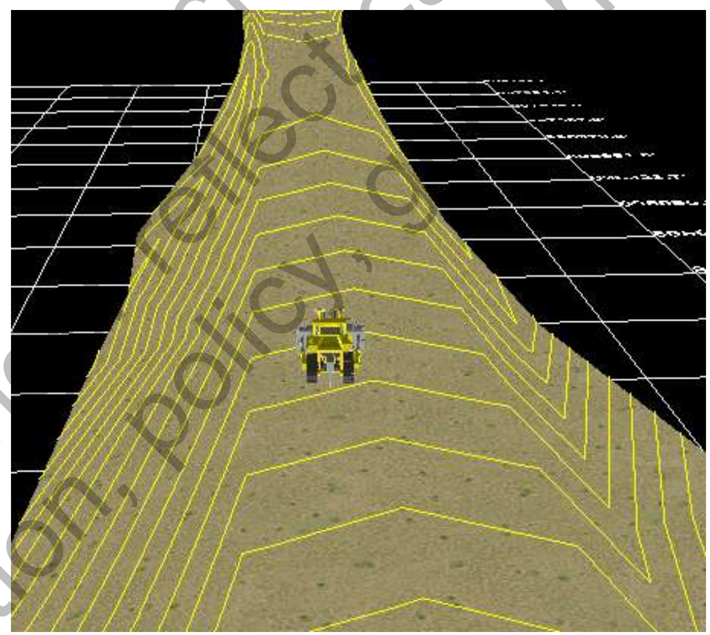
Poll Pod: As-built Data

Do you capture as-built data digitally?

- Contractor provides digital files
- Engineer provides digital files
- Design files updated with paper mark-ups
- Paper record only
- No as-built data is captured

Mobile Device/GPS Rover Applications on the Construction Site

- GPS Rovers Field Inspection QA/QC using 3D Model for Automated Machine Guidance (AMG)/Control (AMC)
- Field Tablet PCs (Pilot) connected to GPS Rovers for more accurate Utility Relocations Inspection and Field Inspection

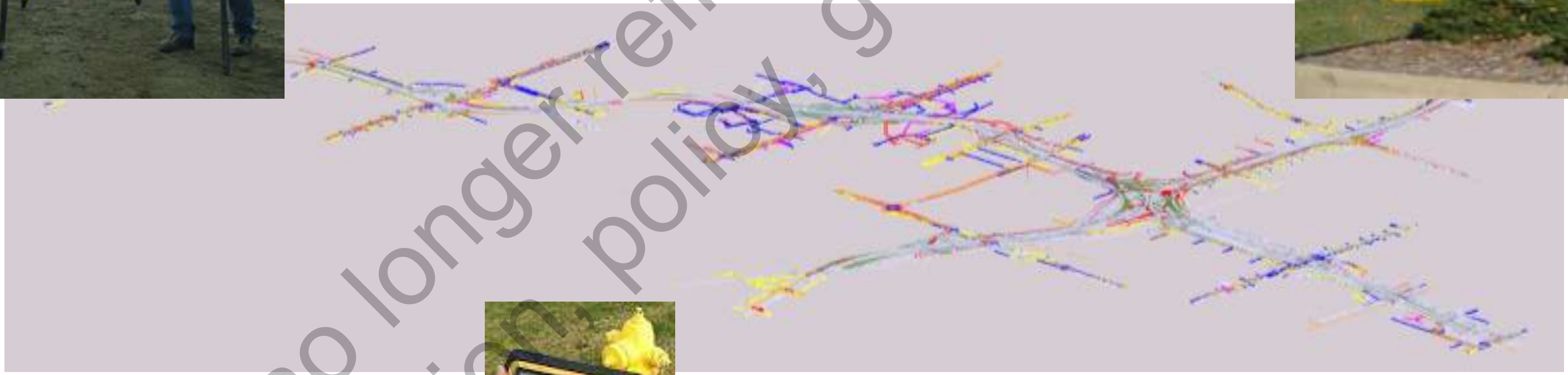


Mobile Device/GPS Rover Applications on the Construction Site

Mobile Device/GPS Rover/Wi-Fi Applications on the Construction Site

Design-Construction Reviews using Tablet PCs & Field Mobile Devices with GPS Rovers connected to Wi-Fi Cloud-based Services

Post-Construction: As-built Record Updating of 3D Models



Construction Trends
UAV/UAS Applications on the Construction Site

Construction Unmanned Aerial Vehicle/System (UAV/UAS) Applications: Construction Monitoring, Traffic Monitoring, Data Collection, LiDAR, Remote Sensing, QA/QC, As-builting, Asset Management, etc.

Construction Trends
UAV/UAS Applications on the Construction Site

In-progress and Post Construction Data Collection using UAS/UAVs - <100 lbs, <400 ft Ceiling, Cameras, On-board Stability, GPS, IMU, LOS, Need COA, High-resolution Aerial Imagery, Videos, LiDAR, Infared, etc.

Construction Trends
UAV/UAS Applications on the Construction Site

In-progress and Post Construction Data Collection using UAS/UAVs - <100 lbs, <400 ft Ceiling, Cameras, On-board Stability, GPS, IMU, LOS, Need COA, High-resolution Aerial Imagery, Videos, LiDAR, Infrared, etc.

Questions

Thank you! Feel free to contact me directly.

Lance Parve, Sr. Project Engineer
WisDOT SE Freeways Design-Construction
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C.414.750.1330 / C.414.731.5375

Verify Learning Outcomes

- Describe applications and support activities using 3D and 4D models for construction
- Discuss construction site survey requirements for using 3D models
- Describe ways an owner can use 3D models to reduce risk of change orders, delays and claims

Supporting AMG on site for QA

John Lobbestael, P.S.
Michigan Department of Transportation

Every Day Counts

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U.S. Department of Transportation
Federal Highway Administration

Learning Objectives

- Discuss how a contractor's work plan can manage use of 3D models on site
- Discuss the training needs for Construction Engineers and Inspectors
- Describe different approaches to procuring equipment and training for the owner's representatives

Poll Pod: QA when the Contractor uses AMG

How do you QA stakeless/wireless/ stringless construction?

- QA method agreed and documented in the Contractor's work plan; varies by activity and experience level
- Agency Rovers and reviewed Model to verify tolerances
- Agency Rovers to survey and compare to plans
- Agency Static LiDAR to survey and compare to plans
- Borrow Contractor's Rovers to check tolerances against Contractor's model
- Observe Contractor's checks with their Rover and Model
- Contractor sets stakes and/or hubs and strings/wires

Overview

- General Comments
- Equipment & Training
  - – Procurement Options
  - – Building Competency
- Contractor's Work Plan / Intent
- Verifying Construction Accuracy / QA
- Measurement

Poll Pod: Contractor use of AMG

Are contractors using AMG on your projects?

- GPS/GNSS for earthworks and excavation
- Laser-augmented GPS/GNSS for fine grading
- Laser-augmented GPS/GNSS for paving
- Robotic Total Stations for fine grading
- Robotic Total Stations for asphalt paving
- Robotic Total Stations for concrete paving
- No, but they want to
- Not yet

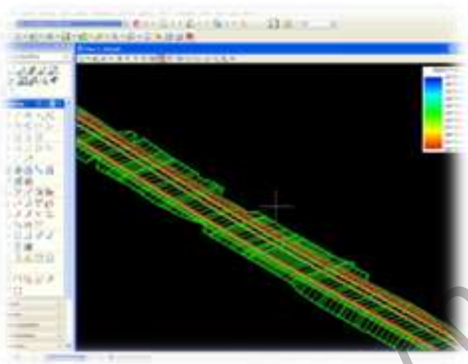
General Comments

- Enable AMG
  - Catch up
- Focus on Quality Assurance
- Utilize Modern Technology

Look Mom, No Strings!

Equipment

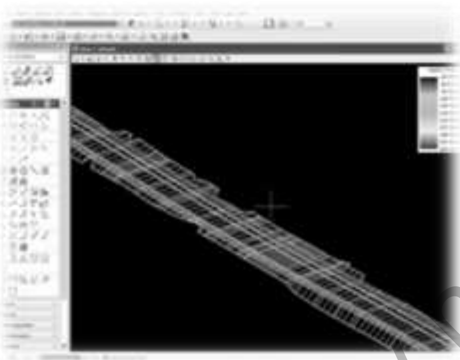
OLD



NEW

Equipment

OLD



NEW

Equipment

Equipment Considerations

- Cost vs. Benefit
- Support
- Procurement
- Training

Equipment Considerations : Cost vs. Benefit

- Robotic Total Station
  - ~$20 k
- GPS Receiver / Antenna
  - ~$20k
- Controller
  - ~$4k
- Digital Level
  - ~$6k

Equipment Considerations : Support

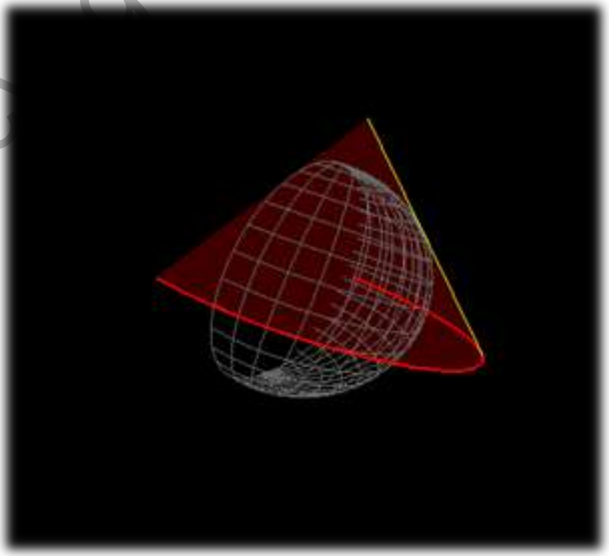
- Hardware
- Software
- Firmware
- Connectivity

Equipment Considerations : Training

- Survey Concepts
- Plan Reading & Data
- Device Specific Concepts
- When to employ which tool
- Troubleshooting

Equipment Considerations : Training – Survey Concepts

- Fundamental Concepts
  - Train Control Freaks!
  - GPS & TPS Do's & Don'ts
  - Units of Measure
  - Coordinate Systems
  - Grid vs. Ground
  - Calculations
  - Data Use
  - Data Collection
  - Field Practices



Poll Pod: Coordinate Systems

What Coordinate System do you use?

- State Plane
- Modified State Plane
- Standardized Low Distortion Projection
- Project Low Distortion Projection
- Local Coordinate System
- Not sure

Equipment : Procurement Options

- Agency Procured
- Contractor Procured
- Consultant

- Pros & Cons

Agency Procured Pros vs. Cons

PROS	CONS
Potential easier to standardize.	Expensive investment
Flexibility on use of equipment.	Need to manage the assets
Don’t need contract language developed.	
Implies independence & competency.	

Contractor Procured Pros vs. Cons

PROS	CONS
Less investment pain	Harder to standardize across a dept.
Contractor provided training	Stipulations on use being project related
Uniformity on a per project basis	Perception of dependence

Consultant Services Pros vs. Cons

PROS	CONS
Equipped, knowledgeable provider	Does not build internal competency
Absorbed into project CE costs	Scheduling / administration burdensome
Delegation & division of tasks optimal for some projects	Costly

Contractor’s Work Plan / Intent

- Work with Contractor’s Trade Organization to develop.
- Contractor determines means & methods
- Promote Innovation
- Define Interactions
- Path to problem solving
- Provisions for revisions

Verifying Construction Accuracy / Q.A.
Office Preparations

- Standardize Deliverables
- Make them accessible
- Explore opportunities for data streamlining

Poll Pod: Design Model Review

Do you review design models prior to releasing them pre- or post-award?

- Review for conformity with standards
- Review for completeness
- Review for consistency with plans
- Review for constructability
- Review for utility of the data
- No design model review

Core Information

- A model contains information to answer: Where do we put this project and the proposed design features contained within it?
  - Foundation: NSRS   Language: Station Offset

Which enables:

- A direct import of all project alignments to roading software on a survey device (MS Field Genius) in seconds!

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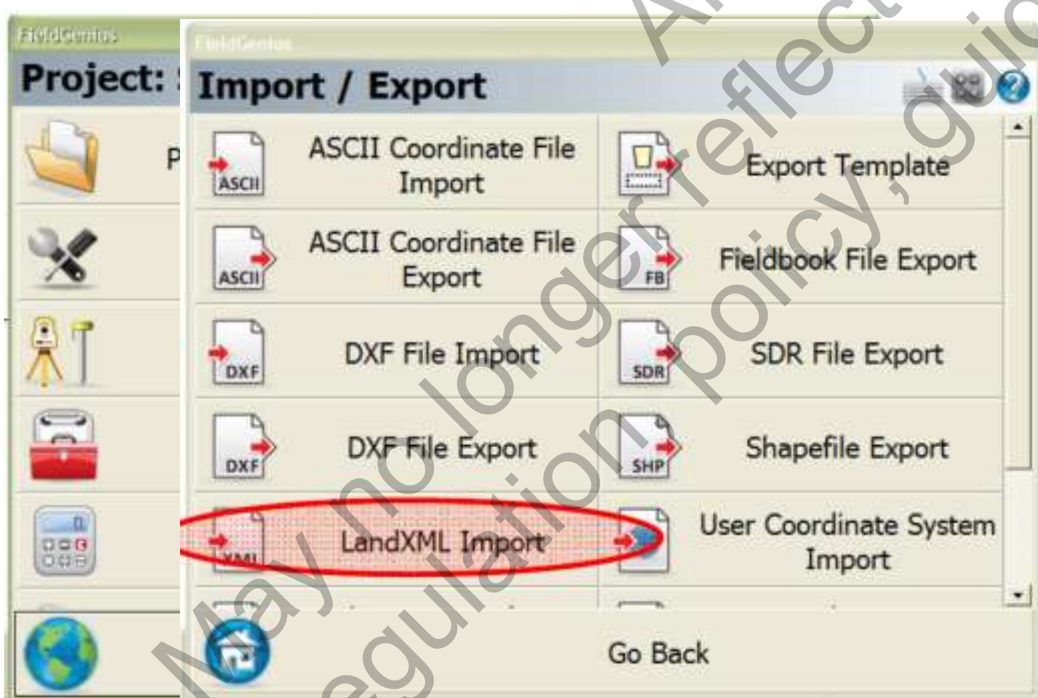

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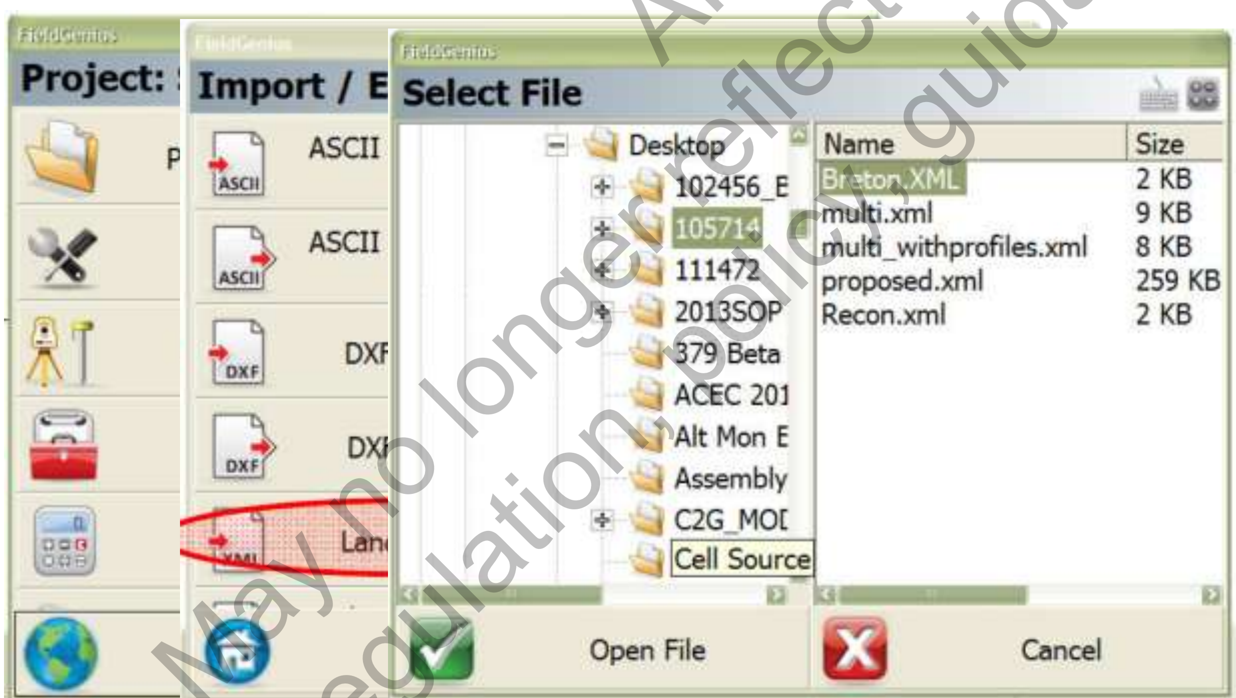

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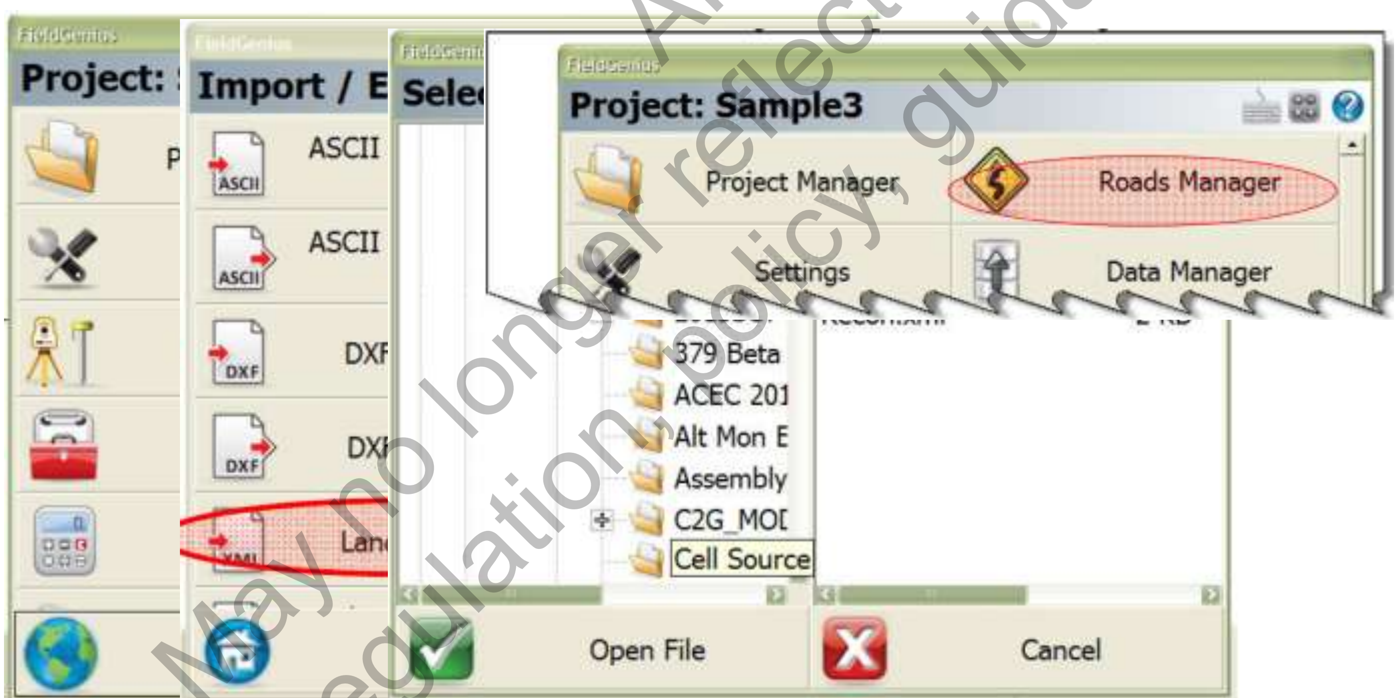

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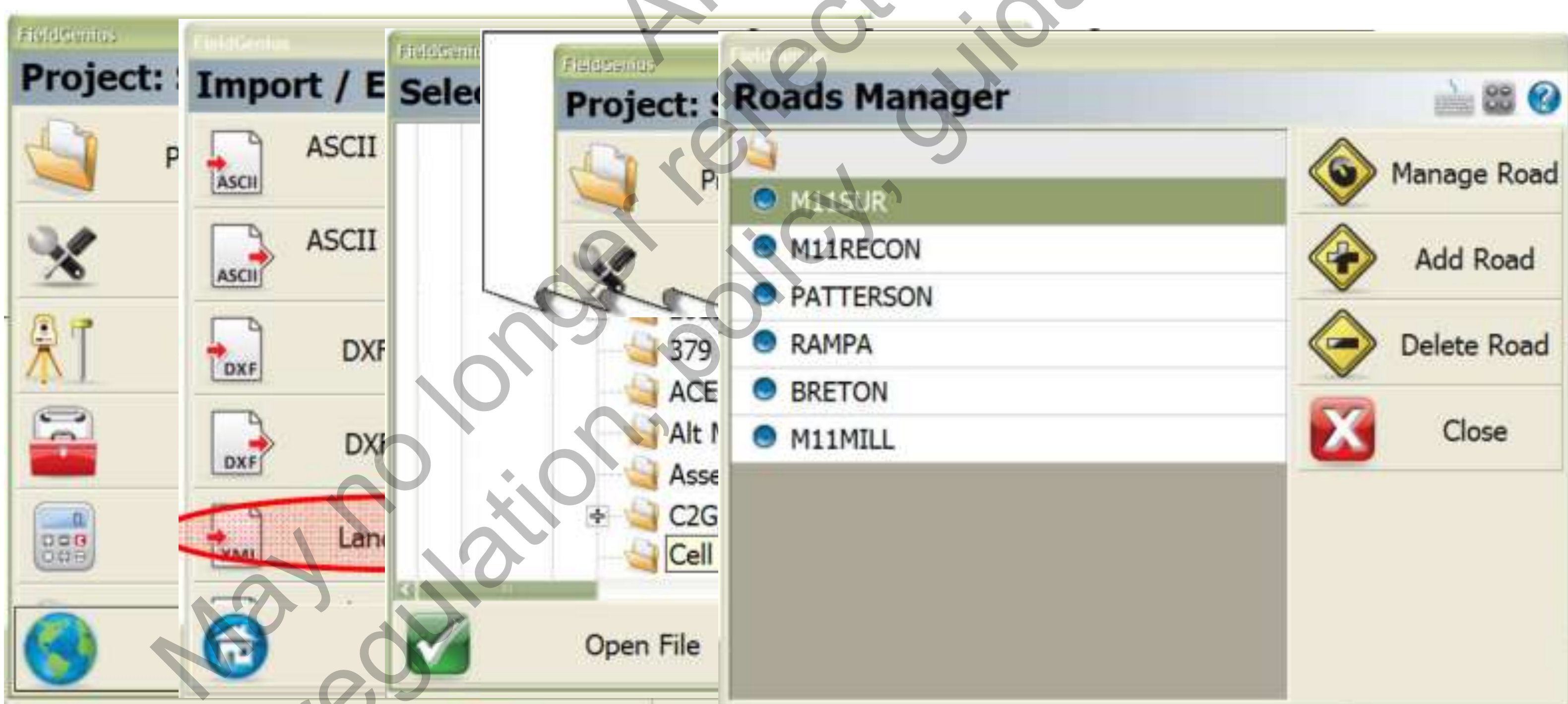
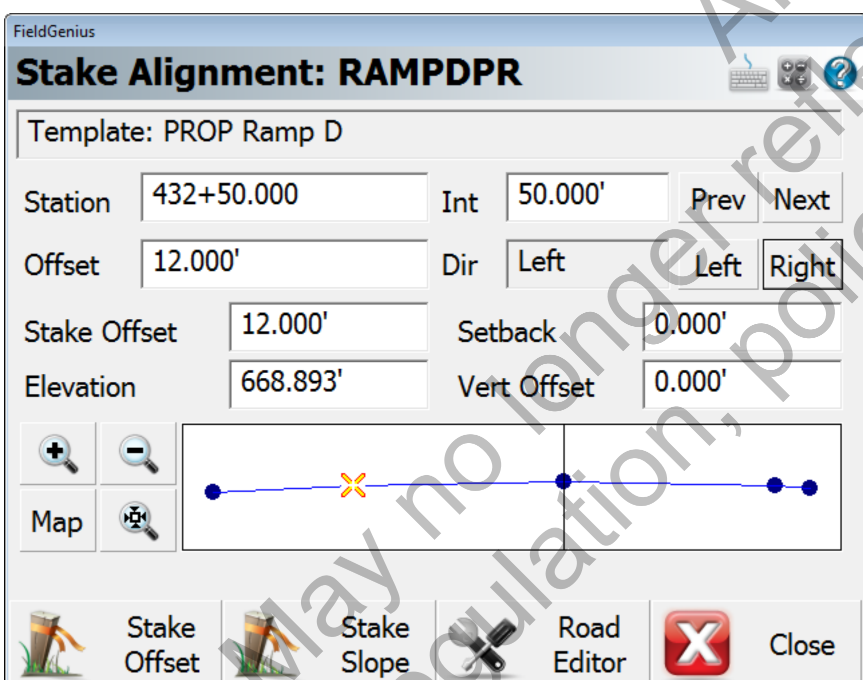
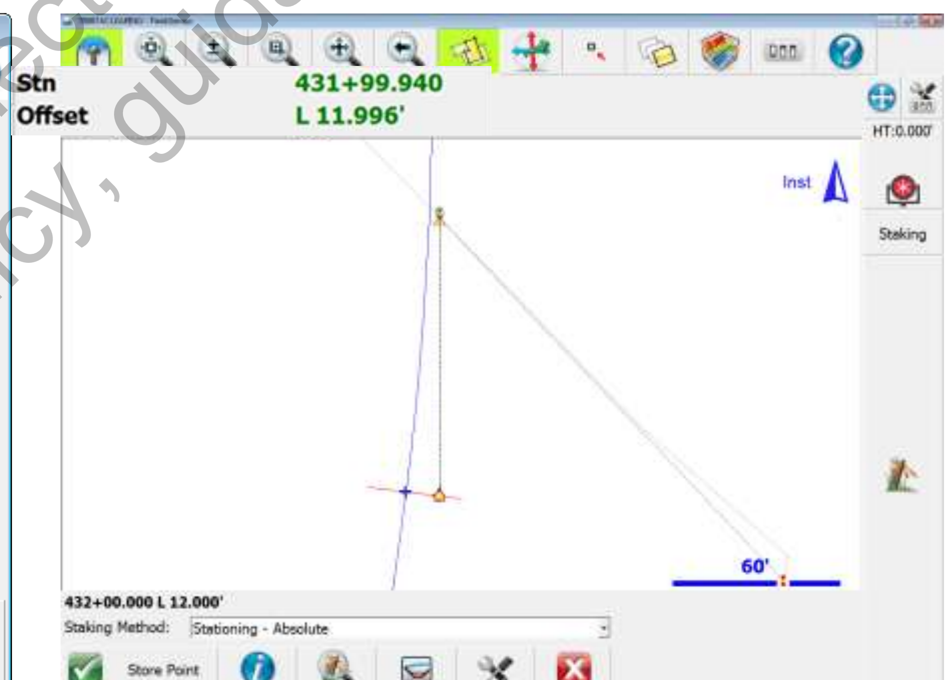


This allows the user to:

- See x,y position relative to station – offset & record observations in automated reports relative to same.





Without it…

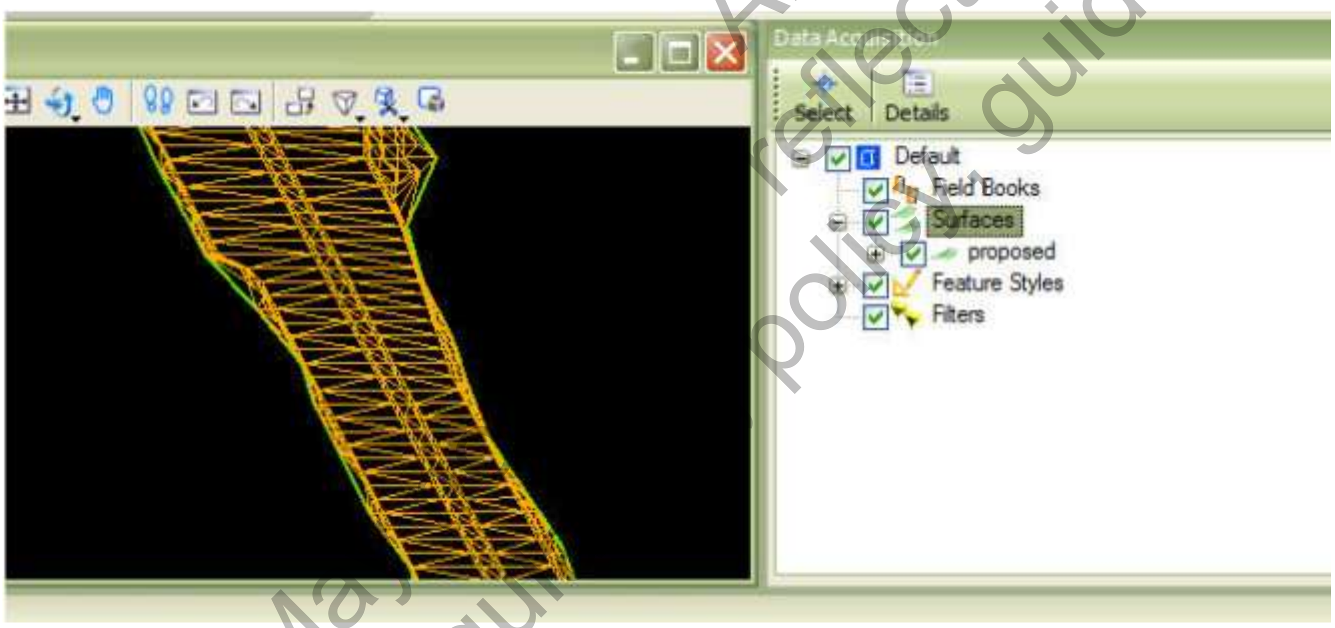
1. Un-roll paper plan set
2. Manually key in each tangent and curve section
3. Assign stationing

- Subject to entry errors.
- On complex jobs with multi alignments – TIME CONSUMING.
- Multiply this tedious function by many users and you have – UNECESSARY TIME LOSS.

- A model contains information to answer: Where is the proposed grade?

Which enables:

- Which enables a direct import of surface .xml into roading software on a survey device in minutes!



Which enables:

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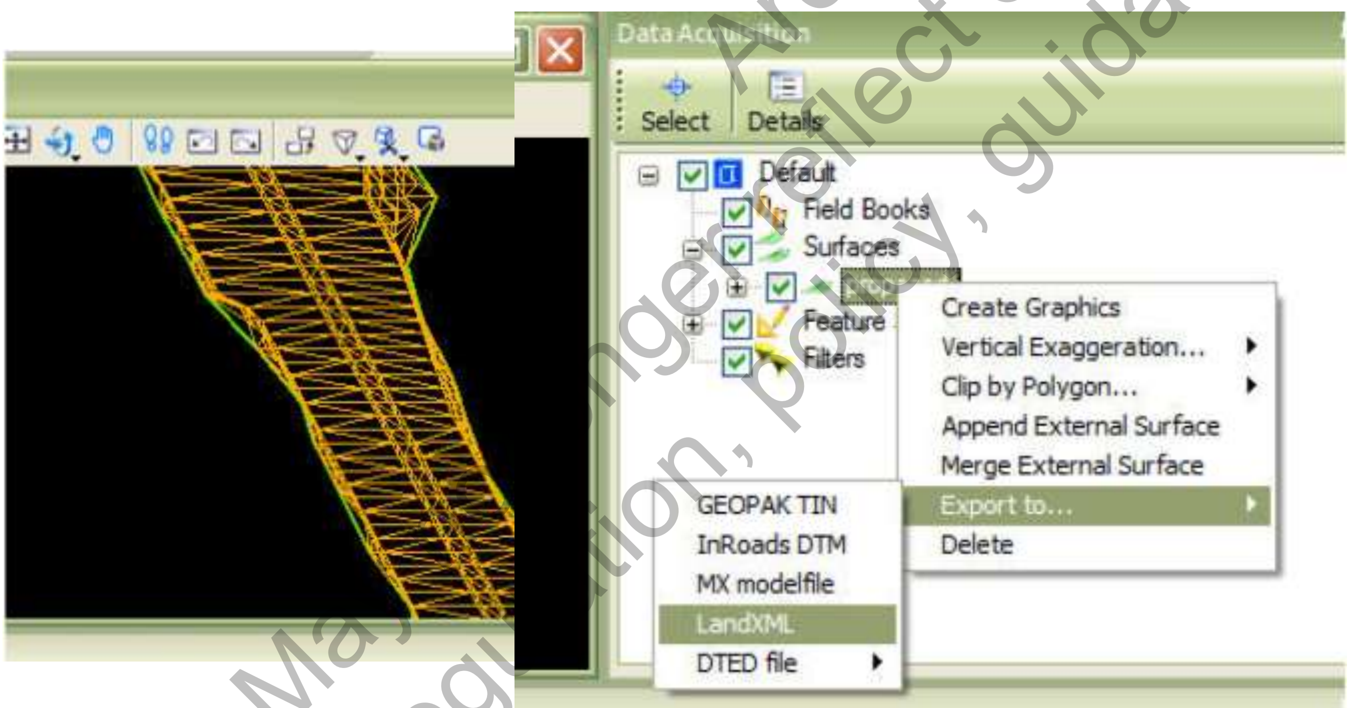

Which enables:

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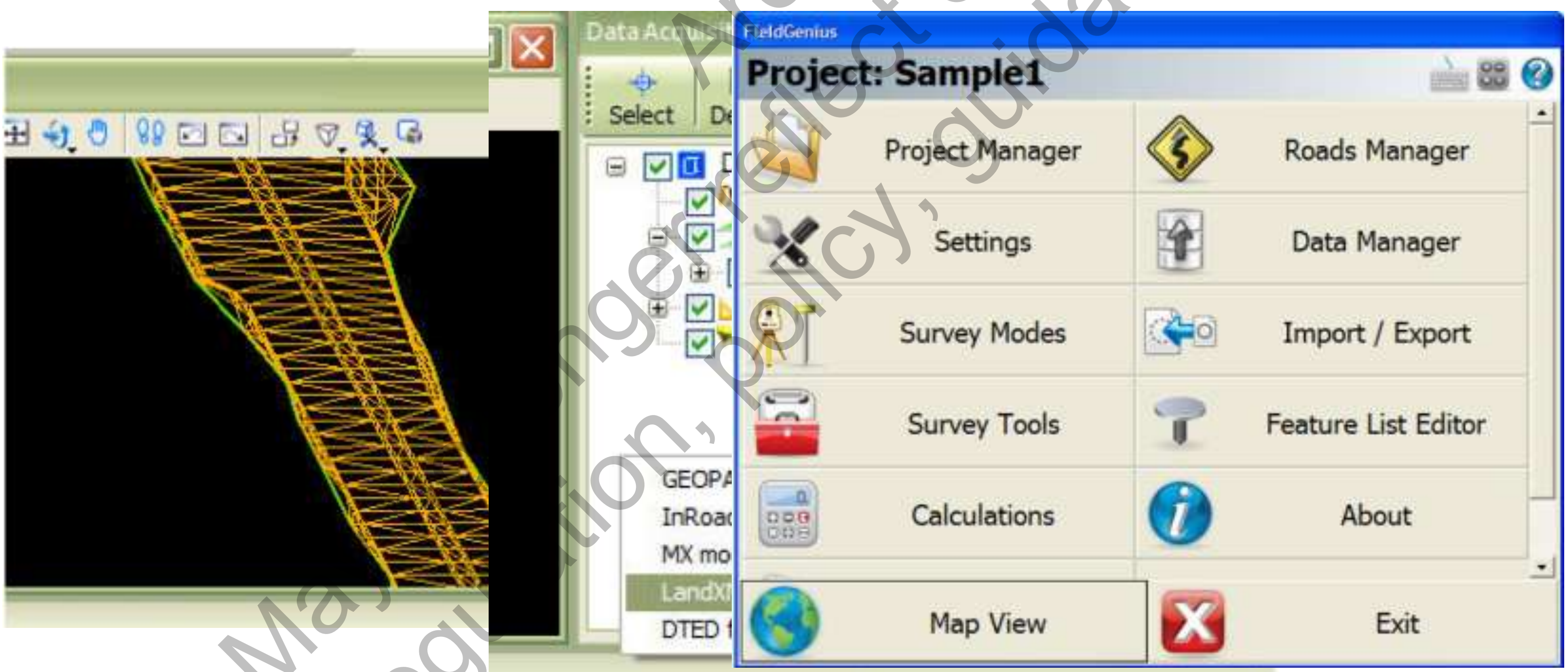

Which enables:

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Which enables:

- Which enables a direct import of surface .xml into roading software on a survey device in minutes!

This allows the user to:

- See x,y,z position relative to proposed grade anywhere on the site & record observations in automated reports relative to same.

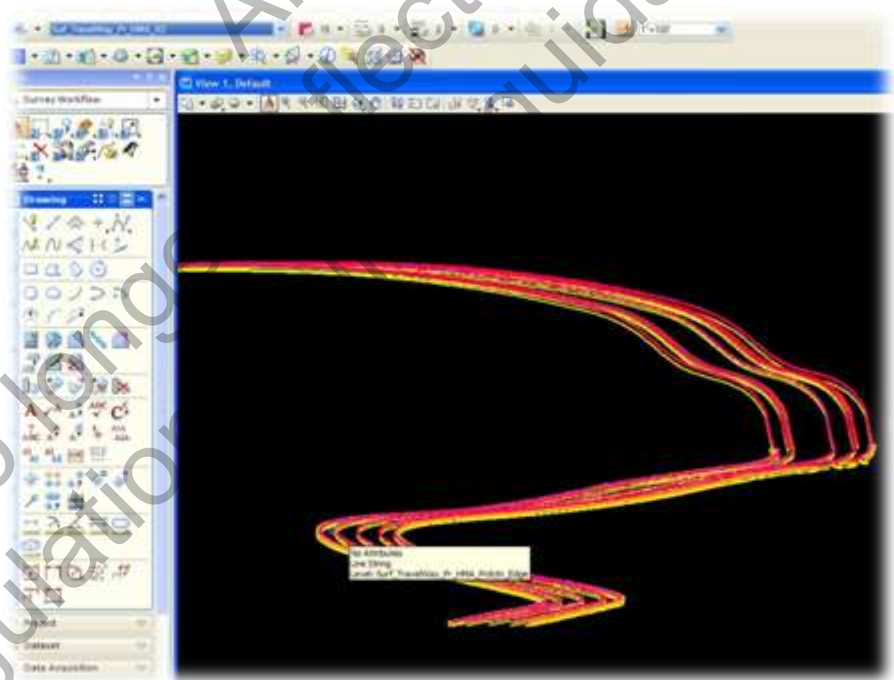
FieldGenius

File Viewer - RAMPDSTAKEOUT.csv

Station	Offset	Offset Length	As Built Pt	Design N	Design E	Design El	As Built El	Cut(-)/Fill(+)	Delta N	Delta E
43200.000	Left	11.996	5022	542095.914	13625583.048	669.884	669.892	-0.008	-0.046	0.039
43250.000	Left	12.007	5023	542054.784	13625612.297	668.893	668.912	-0.018	-0.075	0.043
43300.000	Left	12.031	5024	542012.535	13625639.903	667.743	667.767	-0.024	-0.053	-0.004
43350.000	Left	12.001	5025	541969.231	13625665.825	666.433	666.429	0.004	-0.039	0.021

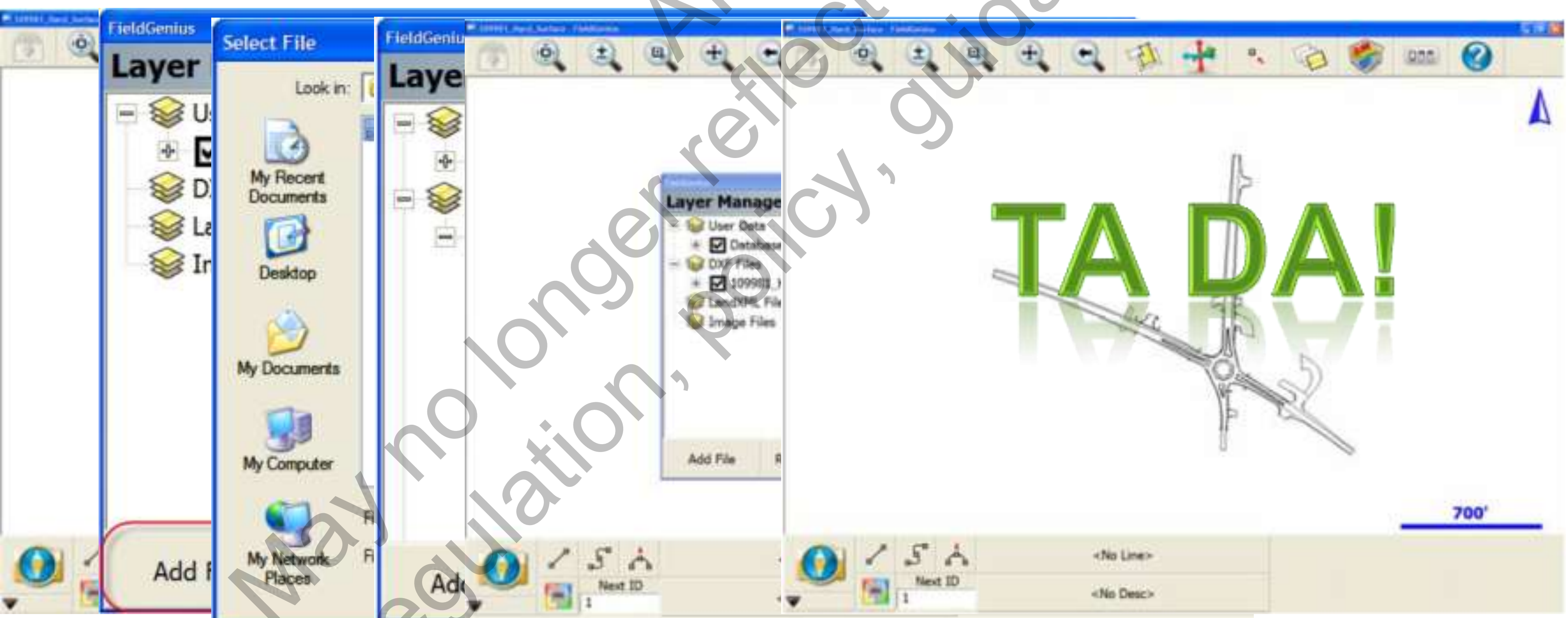
3D Elements

- A model contains information to represent: The true 3D location of proposed objects critical to design.

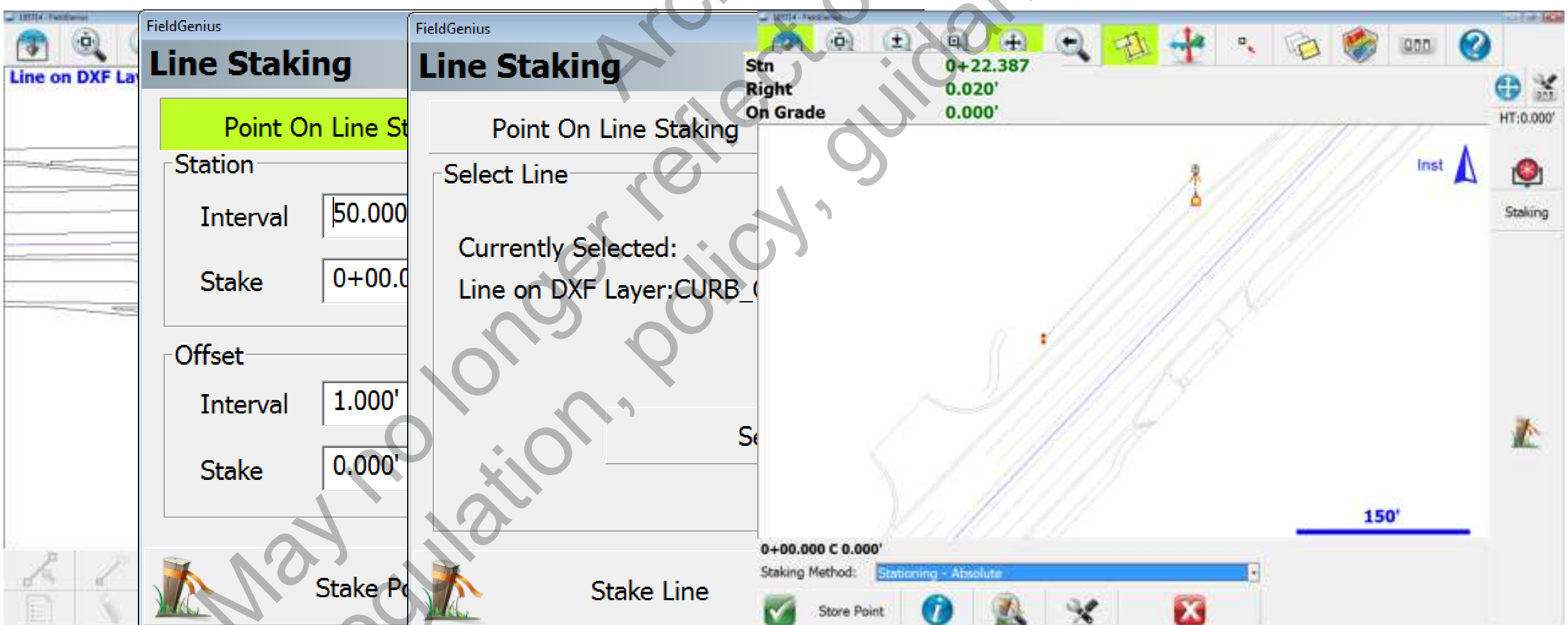


Which enables :

- Which enables a direct import of 3D .dxf into roading software on a survey device in minutes!



- Position relative to a 3D design faster than ever before with little pre-computation of design features!

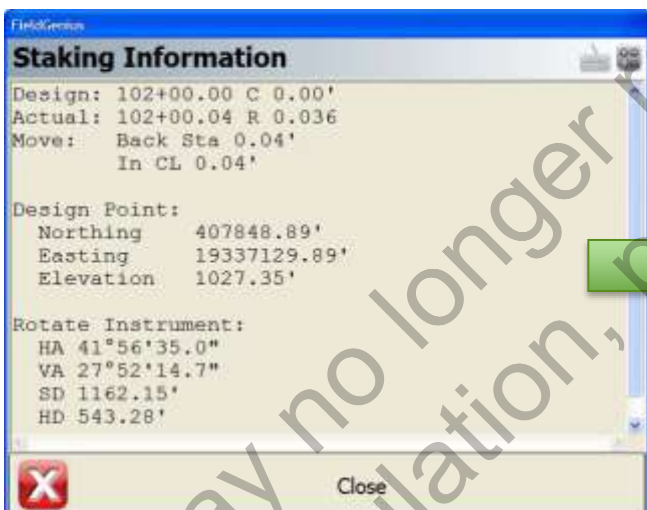


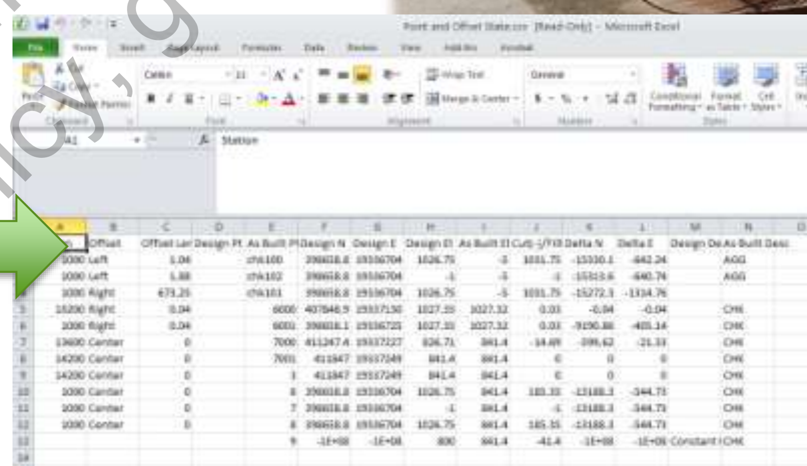
Verifying Construction Accuracy / Q.A.
Pre-Construction Steps - Field

- Recover and check control!
- Protect it!
- Plan approach and tools needed
- Compute scale factor(s) if design on grid.
- Calibrate to the site – lock down!

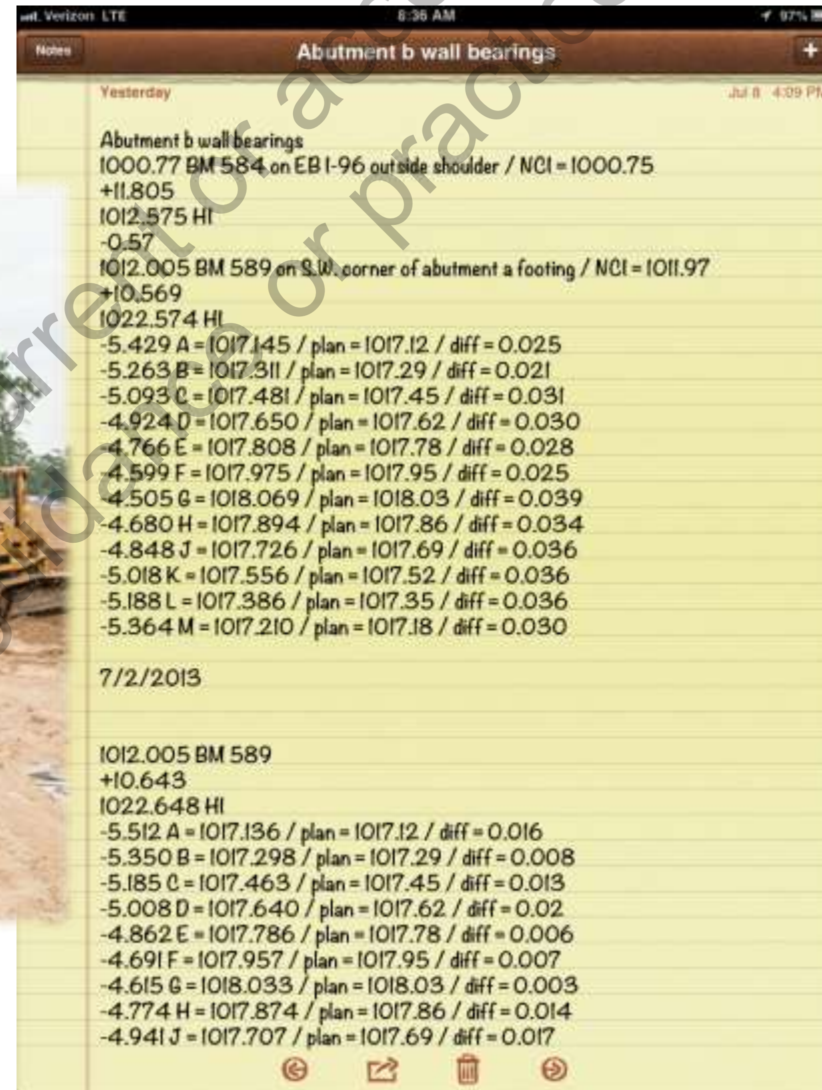
Verifying Construction Accuracy / Q.A. During Construction - Field

- Build comfort
- Spot check often
- Utilize automated reports
- Right tool for the job!





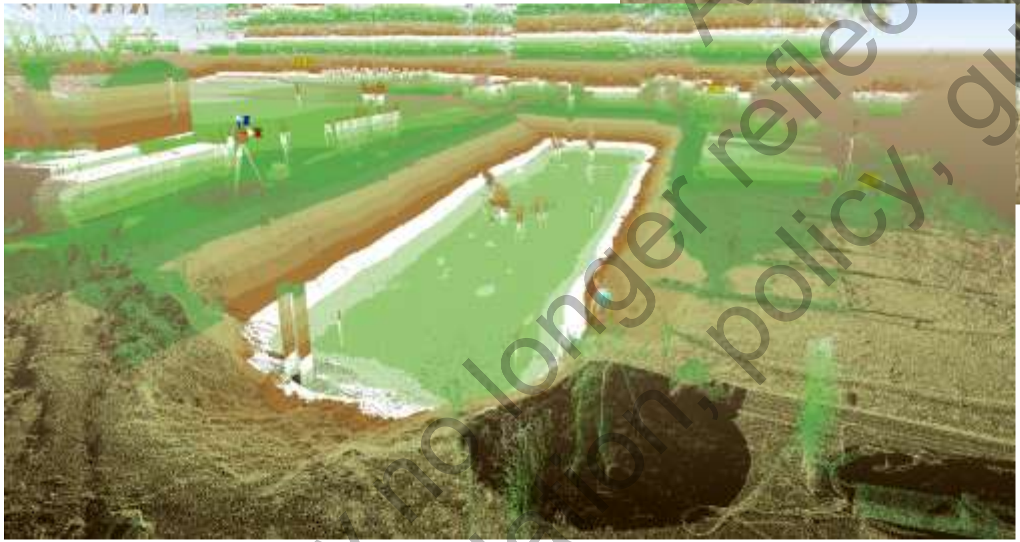
Measurement



Abutment b wall bearings
1000.77 BM 584 on EB I-96 outside shoulder / NCI = 1000.75
+11.805
1012.575 HI
-0.57
1012.005 BM 589 on S.W. corner of abutment a footing / NCI = 1011.97
+10.569
1022.574 HI
-5.429 A = 1017.145 / plan = 1017.12 / diff = 0.025
-5.263 B = 1017.311 / plan = 1017.29 / diff = 0.021
-5.093 C = 1017.481 / plan = 1017.45 / diff = 0.031
-4.924 D = 1017.650 / plan = 1017.62 / diff = 0.030
-4.766 E = 1017.808 / plan = 1017.78 / diff = 0.028
-4.599 F = 1017.975 / plan = 1017.95 / diff = 0.025
-4.505 G = 1018.069 / plan = 1018.03 / diff = 0.039
-4.680 H = 1017.894 / plan = 1017.86 / diff = 0.034
-4.848 J = 1017.726 / plan = 1017.69 / diff = 0.036
-5.018 K = 1017.556 / plan = 1017.52 / diff = 0.036
-5.188 L = 1017.386 / plan = 1017.35 / diff = 0.036
-5.364 M = 1017.210 / plan = 1017.18 / diff = 0.030

7/2/2013

1012.005 BM 589
+10.643
1022.648 HI
-5.512 A = 1017.136 / plan = 1017.12 / diff = 0.016
-5.350 B = 1017.298 / plan = 1017.29 / diff = 0.008
-5.185 C = 1017.463 / plan = 1017.45 / diff = 0.013
-5.008 D = 1017.640 / plan = 1017.62 / diff = 0.02
-4.862 E = 1017.786 / plan = 1017.78 / diff = 0.006
-4.691 F = 1017.957 / plan = 1017.95 / diff = 0.007
-4.615 G = 1018.033 / plan = 1018.03 / diff = 0.003
-4.774 H = 1017.874 / plan = 1017.86 / diff = 0.014
-4.941 J = 1017.707 / plan = 1017.69 / diff = 0.017



Questions?

Questions / Comments

Contact Information

John P. Lobbestael, P.S.
Michigan Department of Transportation
517 335 5550
lobbestaelj@michigan.gov

Verify Learning Outcomes

- Discuss how a contractor's work plan can manage use of 3D models on site
- Discuss the training needs for Construction Engineers and Inspectors
- Describe different approaches to procuring equipment and training for the owner's representatives

Moderated Question & Answer

Francesca Maier, P.E.
Parsons Brinckerhoff

U.S. Department of Transportation
Federal Highway Administration

Question & Answer

Please add your questions to the Q&A Pod

You may add suggestions for poll pods!

Upcoming Webinars and Close

Douglas Townes, P.E.

FHWA Resource Center

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Federal Highway Administration

3D Engineered Models Webinar Series

Webinar 1: Overview of 3D Models for Construction
Webinar 2: Creating 3D Engineered Models
Webinar 3: Applications of 3D Models in the Contractor's Office
Webinar 4: Applications of 3D Models on the Construction Site
Webinar 5: Managing and Sharing 3D Models for Construction
Webinar 6: Overcoming Challenges to Using 3D Models for Construction
Webinar 7: Implementing 3D Engineered Models for Construction
Webinar 8: Adding Time, Cost and other Information to 3D Models

Up Next: Webinar 4

Managing & Sharing 3D Models

May 7, 2014

1:00 pm – 2:30 pm

www.fhwa.dot.gov/3D

Douglas.townes@dot.gov