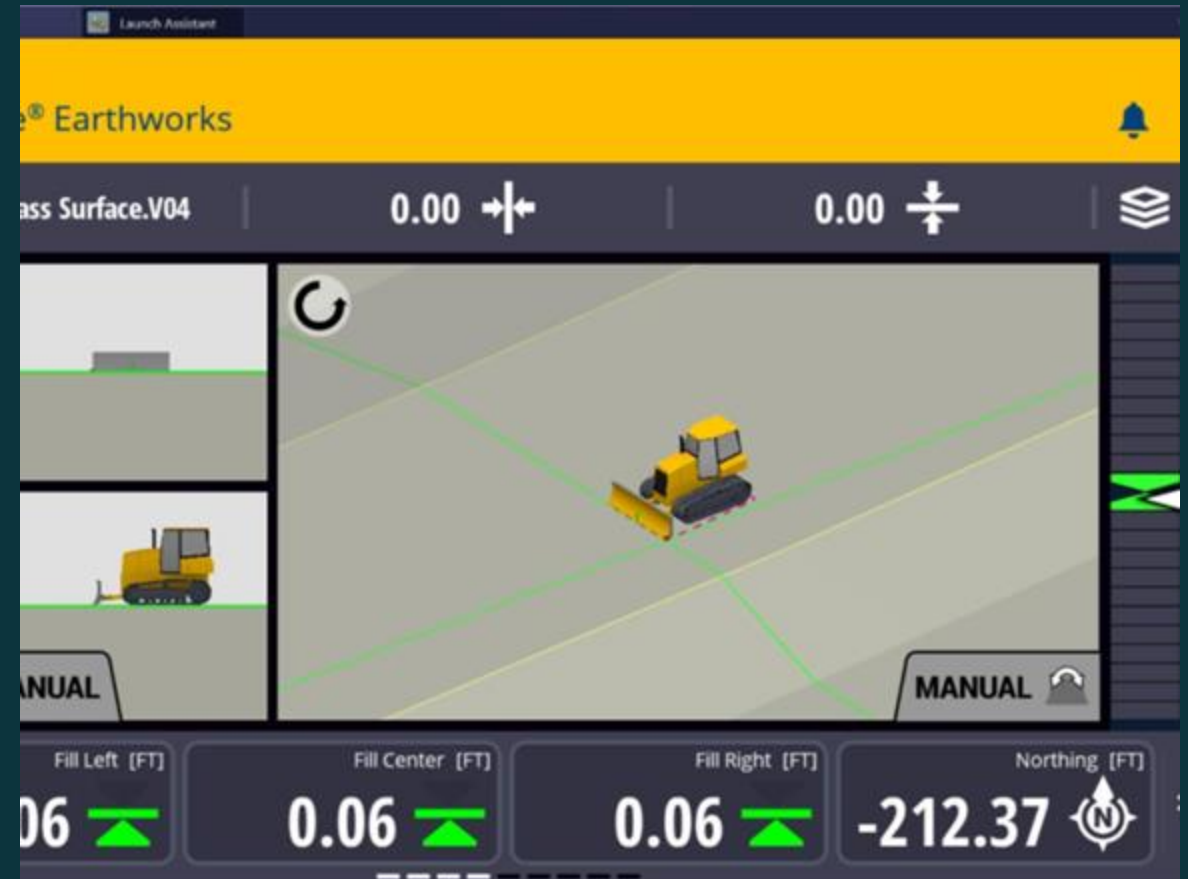
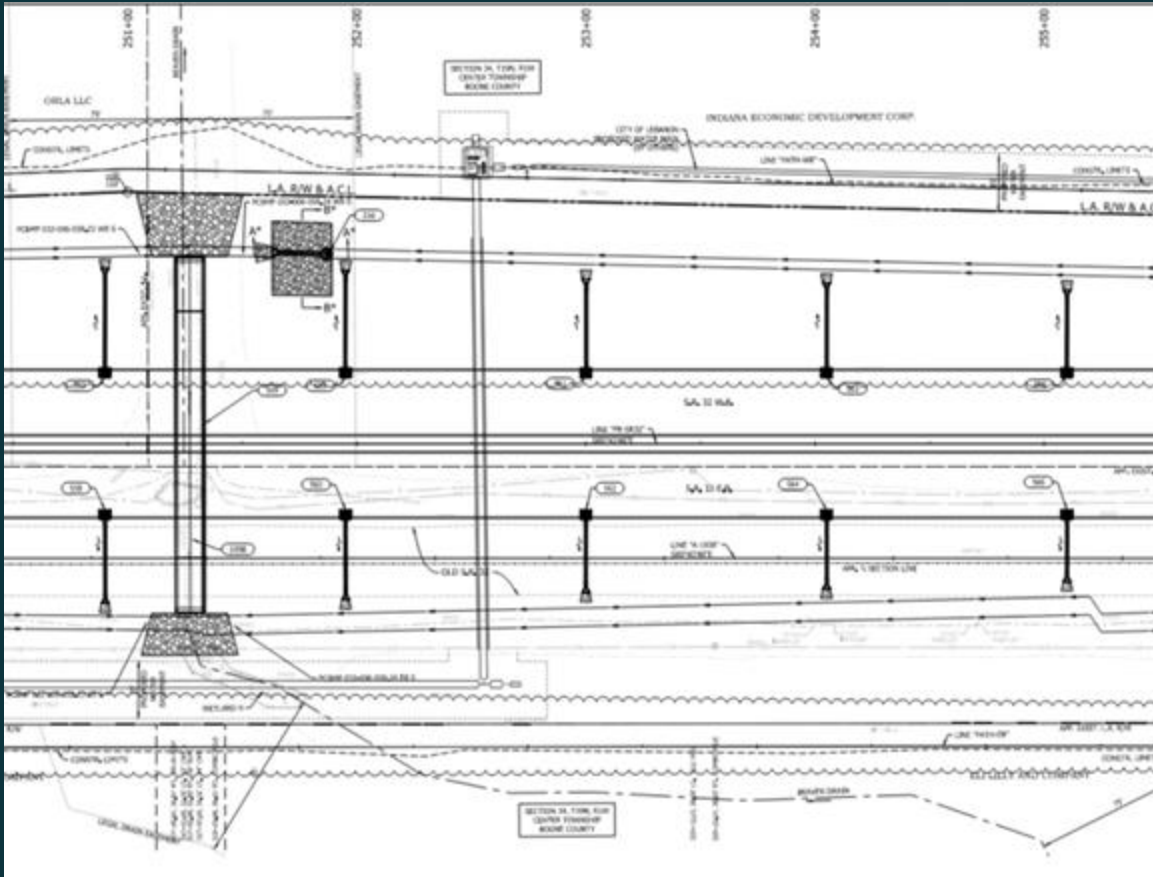


BRIDGING THE GAP

FROM DESIGN TO 3D MACHINE CONTROL MODELING



PROGRESSION OVER TIME



GUNTER'S CHAIN EXPLAINED

— The Tool That Shaped Early Surveying —

1 WHAT IS IT?

The Basics

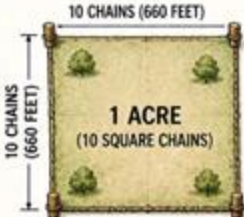
- 66 feet long
- 100 metal links
- Standard surveying tool (1600s–1800s)



2 WHY 66 FEET?

Designed for Simplicity

- 10 square chains = 1 acre
- Easy land area calculations
- Used for property division



10 CHAINS (660 FEET)

10 CHAINS (660 FEET)

1 ACRE
(10 SQUARE CHAINS)

i 1 Chain = 66 Feet
1 Square Chain = 66 ft x 66 ft = 4,356 sq ft
10 Square Chains = 43,560 sq ft = 1 Acre

3 HOW IT WAS USED

Field Measurement



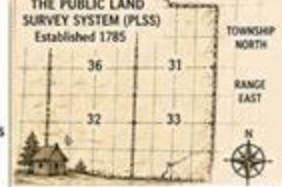
- Stretched between points
- Repeated for long distances
- Required teamwork and precision



4 HISTORICAL IMPACT

Shaping Land Boundaries

- Used in early U.S. surveys
- Helped define property lines
- Basis for many modern boundaries



THE PUBLIC LAND SURVEY SYSTEM (PLSS)
Established 1785

TOWNSHIP NORTH

RANGE EAST

N

Many property boundaries today trace back to measurements taken with Gunter's Chain.

5 THEN vs. NOW

Evolution of Surveying

THEN: GUNTER'S CHAIN



- Manual measurement
- Labor intensive
- Based on physical links and steps
- Accuracy through skill and experience

NOW: MODERN TECHNOLOGY



- Digital & satellite based
- Faster, safer, more efficient
- High precision measurements
- Integrated with CAD, GIS & BIM

SAME GOAL: ACCURACY

6 WHY IT STILL MATTERS

The Legacy



Foundation of measurement standards



Influenced modern surveying systems



Important part of surveying history

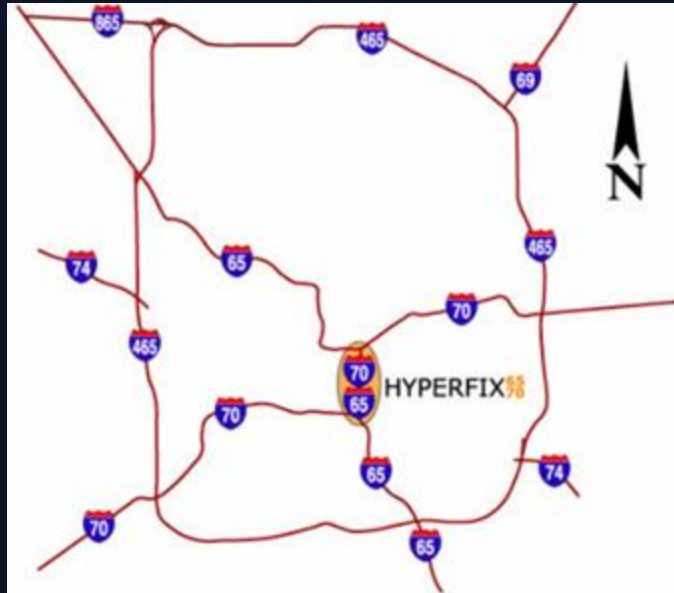
A LEGACY THAT MEASURES THROUGH TIME



1600s → 1800s → 1900s → TODAY

From Chains to Coordinates

SPEAKER - TONY LUSK



THINGS WE NEED TO BUILD A MODEL



CAD Files

- Linework (DGN, DWG, DXF, or XML)
- Proposed Surface (XML, TIN, TTM, DTM)
- Existing Surface (XML, TIN, TTM, DTM)
- Alignments & Profile Data



Control Points

- CSV files of control (or txt)
- Coordinate system info
- Benchmark elevations



Plans & Specs

- Latest Plan Set
- Typical Cross Sections
- Grading & Drainage Details

PRO TIP: Ensure US Survey Feet vs. International Feet are clarified before model building begins to avoid conflicts.

U.S. SURVEY FOOT *VS.* INTERNATIONAL FOOT

U.S. SURVEY FOOT

1200 / 3937 meters
 ≈ 0.3048006096 m



INTERNATIONAL FOOT

0.3048 meters
exactly



DIFFERENCE:

0.0000006096 m per foot



**OVER DISTANCE,
IT ADDS UP.**

U.S. SURVEY FOOT

INTERNATIONAL FOOT

1 MILE (5,280 FEET)



≈ 0.01 FEET
DIFFERENCE
AT 1 MILE

PRO TIP: Ensure US Survey Feet vs. International Feet are clarified before model building begins to avoid conflicts.

WHY WE NEED CERTAIN CAD FILES

Linework (DGN, DWG, DXF)

Essential for defining the horizontal geometry and boundaries of the project.

- Provides the line features for the 3D model.
- Enables precise machine positioning relative to design features.

Proposed Surface Models (XML)

Defines the vertical component (elevations) for existing and proposed grading.

- Allows for accurate volume calculations and cut/fill mapping.
- Enables automated blade/bucket control for precise grading.

Alignment & Profile Data

Provides the geometric centerlines and vertical slopes required for roadway modeling.

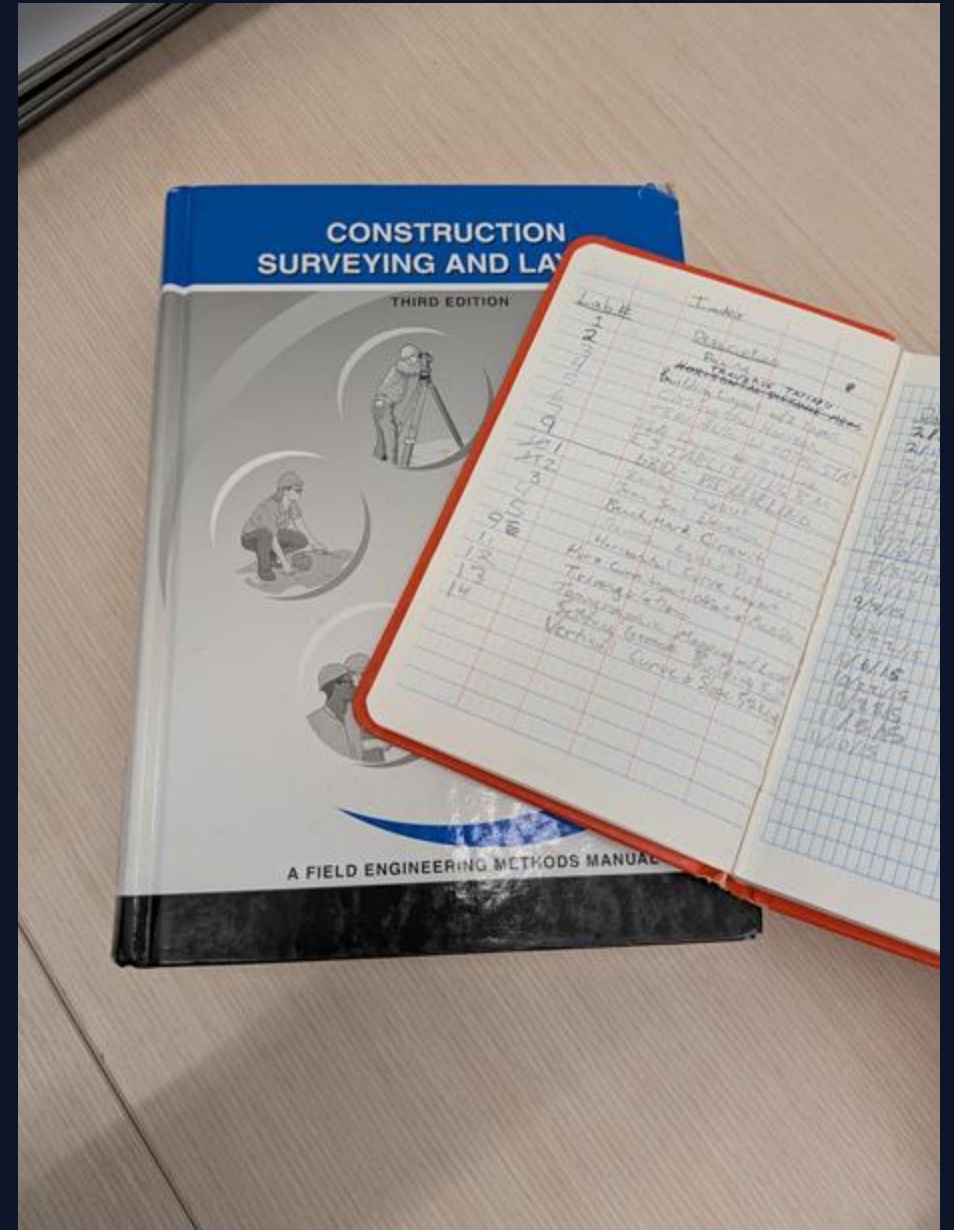
- Crucial for linear assets like corridors.
- Ensures correct stationing and elevation along the design path.
- Provides smooth horizontal and vertical curves to the corridors

Existing Surface Models (XML)

Defines the vertical component for tie-in locations.

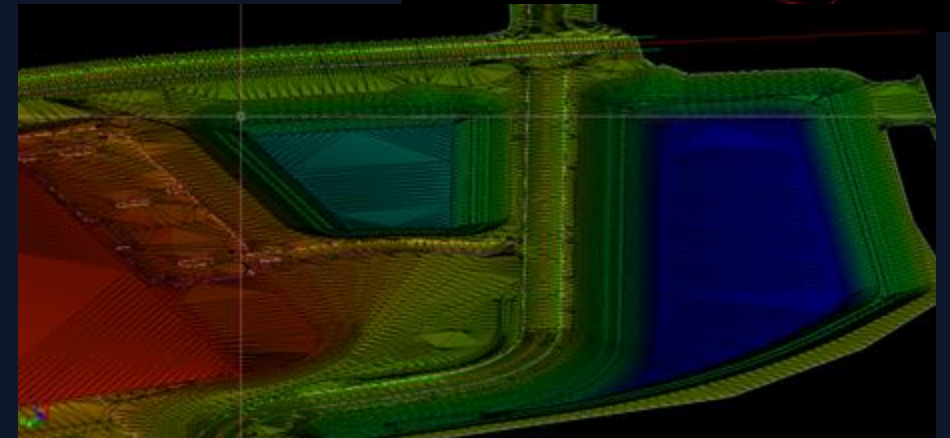
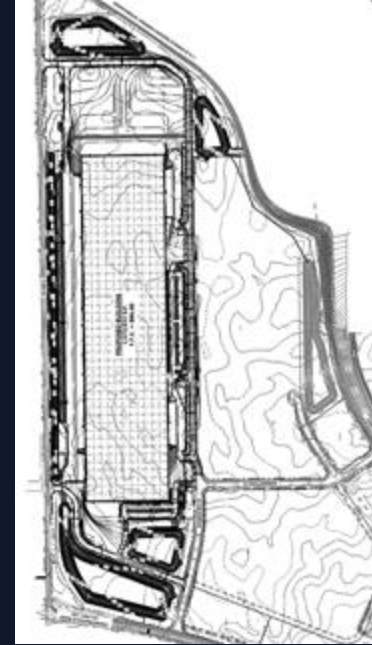
- Great for side ditch slope tie-ins.
- Ensures roadway tie-in smoothness from existing roadway to proposed roadway.
- Also used for a check when doing cross-section checks

SPEAKER - BOBBY STEELE

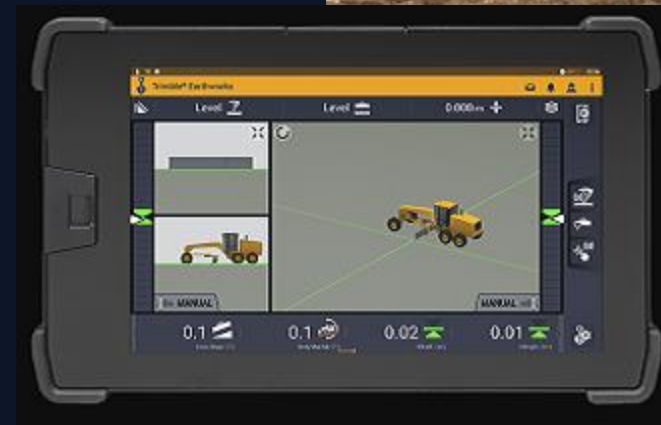
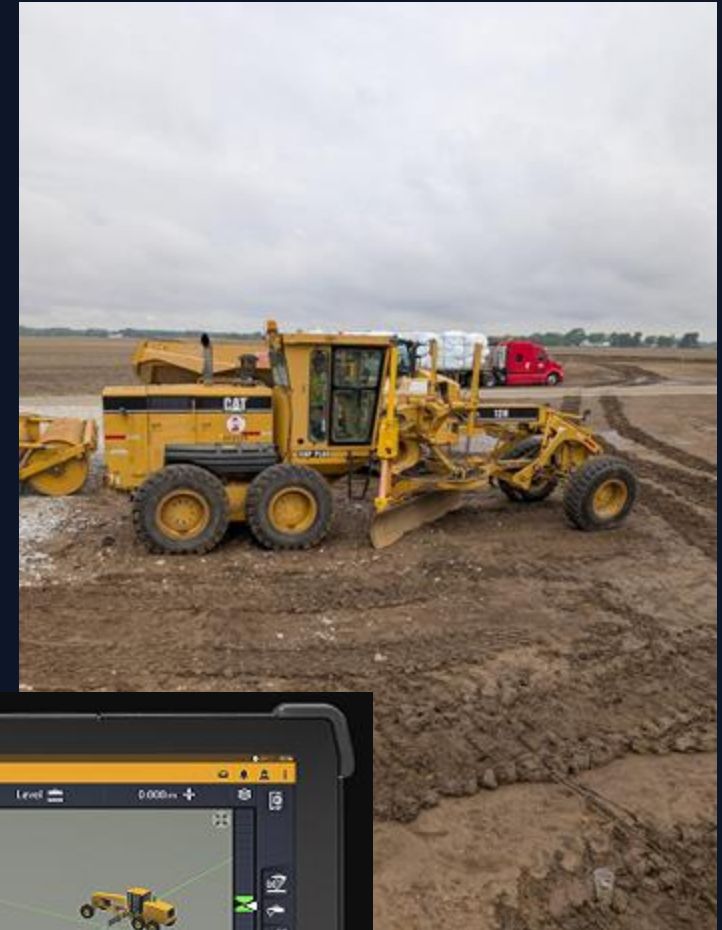


ROADMAP

- ✓ Obtain Cad Files:
 - DXF of linework (or DGN DWG or XML)
 - CSV files of control
 - XML of proposed surface if available
- ✓ Build the Model: Trimble Business Center
 - Alignment, Profile, Corridors, Elevating Linework, and Matching Tie-in's
- ✓ Equipment Ready:
 - Export 3D model
 - Various file types due to equipment constraints



MODEL USE



MACHINE CONTROL: PRECISION IN MOTION



STAKELLESS GRADING

Eliminate the need for physical grade stakes on site.

Models loaded directly into dozers allow for immediate, accurate cutting without waiting for surveyors.



MAXIMIZED EFFICIENCY

Move dirt once. Reduce "re-work" by hitting subgrade targets on the first pass.

Real-time blade positioning ensures the grader cuts exactly to the predicted reality.



MATERIAL CONTROL

Tight tolerances on subgrade mean less wasted stone and asphalt.

Precision grading protects the bottom line by controlling expensive material yields.

GPS VS. UTS

GNSS (Global Navigation Satellite System)



Tolerance: 0.02'-0.10' vertically

Cuts and Fills, Dirt Grading, Rough Layout

UTS (Universal Total Station)



Tolerance: 0.001'-0.02'

Fine Grading, Paving (HMA & Concrete), Curb

Fun Fact: GPS is slang for GNSS. GPS is a U.S. owned satellite constellation of its own.

UTS PAVING: MILLIMETER ACCURACY



VERTICAL PRECISION

Maintains exact mat thickness.

Robotic Total Stations provide constant vertical corrections for a superior ride quality.



SMOOTHNESS BONUS

Eliminate "waves" caused by manual screed adjustments.

Achieve higher IRI scores to secure maximum performance bonuses on DOT projects.

IRI stands for International Roughness Index



YIELD OPTIMIZATION

Control expensive asphalt yields by paving to a precise 3D design.

Reduce material overruns and ensure the exact tonnage is placed where needed.

UTS CURB: STRINGLESS PERFECTION



NO STRING LINES

Eliminate the cost and labor of setting physical stringlines.

Faster setup times allow the crew to start pouring as soon as the machine is on site.



TIGHT RADII CONTROL

Robotic Total Stations track the machine in real-time for perfect curves.

Achieve complex geometric designs that are nearly impossible with manual methods.



DRAINAGE ACCURACY

Maintains precise vertical elevation to ensure proper water flow.

Minimize ponding and "birdbaths" by following the 3D model with millimeter precision.

UTS CURB: PRECISION IN THE FIELD



AUTOMATED SENSORS

Sensors receive real-time data from the UTS to adjust height and steering instantly.



ROBOTIC TRACKING

The UTS provides constant, millimeter-accurate positioning data to the machine.



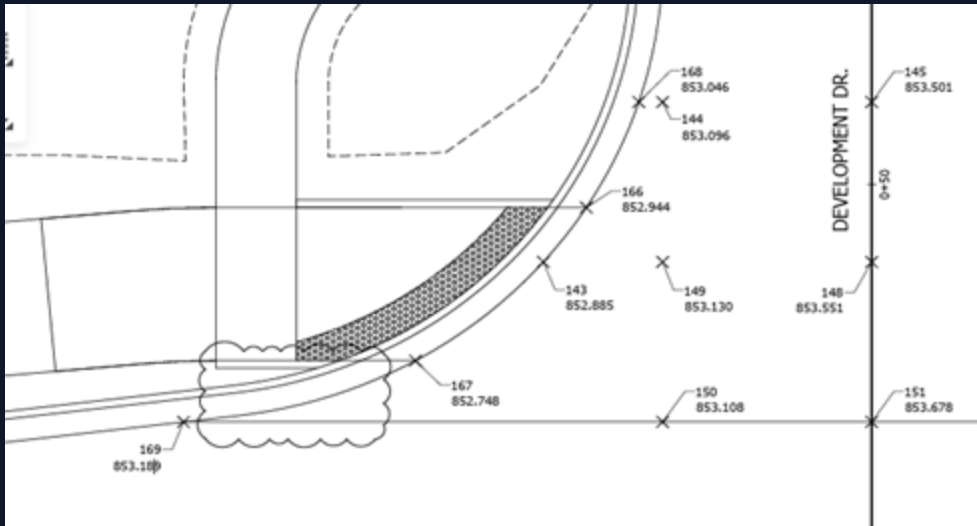
SUPERIOR FINISH

Eliminating human error in stringline setup results in a flawless, consistent concrete extrusion.

MODEL USE

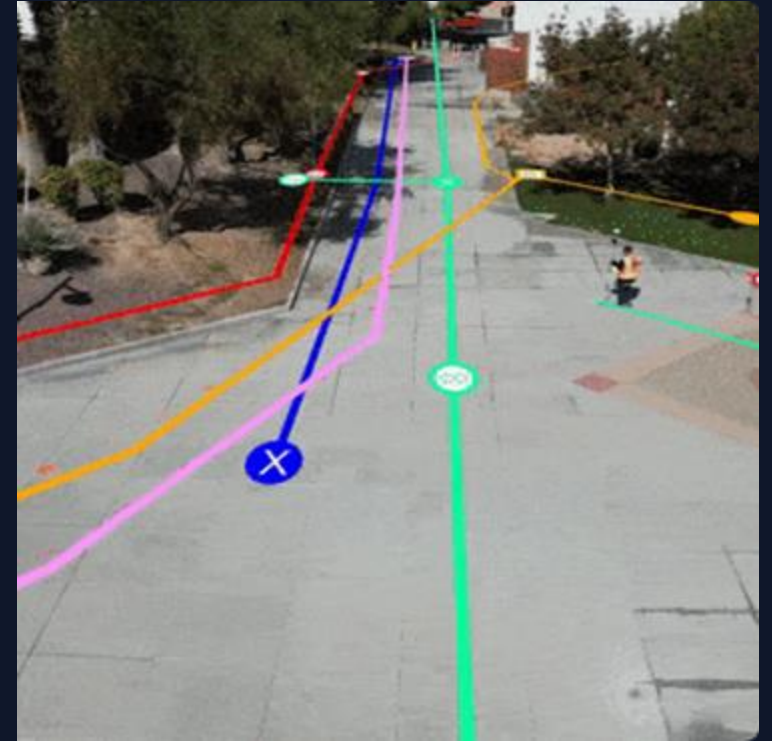


- Lack of drainage information

[illegible]

HIDDEN CONFLICTS

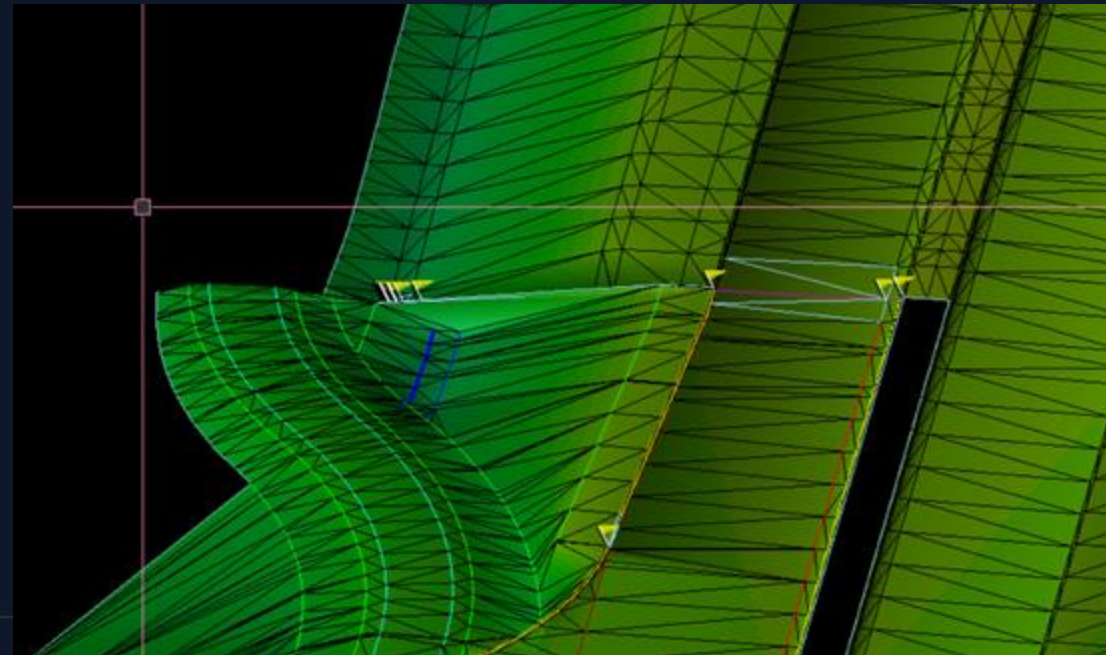
- ✓ Theoretical vs. Physical: A CAD line doesn't account for the 24" bucket width digging next to it.
- ✓ Utility Drift: Recorded locations are often feet away from actual physical location. Big hidden conflict if adding utilities to a 3D model
- ✓ Site Staging: Determine the optimal locations for material stockpiles and cut areas. The model must accurately represent the "Work Zone," extending beyond the intended asset.



THE GAME OF "TELEPHONE"

- ✓ Coordinate Mismatch: Designer's Coordinates vs. Coordinates stated in the plans.
- ✓ Export Loss: LandXML to Proprietary Formats (Trimble/Topcon) often strips data.
- ✓ Resolution: Make that phone call and ask what file formats to send
- ✓ Revisions / Design Changes: Where do I begin? What data do I use? Am I using the most updated set?

"Hey... there's a bust in your model!" — Every crew, every time. Said with so much passion...



OPPORTUNITIES

- ✓ Add'l Info: Location Route Survey added to the plan set
- ✓ Add'l Info: Survey Field Book
- ✓ Add'l Info: Rim Elevations in the structure data table
- ✓ Add'l Info: Line work and surface files

	_ExistDTM	Microsoft Edge HTML Do...	1,752 KB
	_ExistDTM.dtm	DTM File	7,041 KB
	5-8509 - KY 245	KMZ	2,485 KB
	Existing Contours	DGN File	13,744 KB
	Final Earthwork Calcs_KY245	Microsoft Excel Worksheet	139 KB
	KY 245 Alg	Microsoft Edge HTML Do...	41 KB
	KY 245 Control Points	Microsoft Excel Comma S...	1 KB
	KY 245 Suerelevation Report	PDF Document	78 KB
	KY 245 Superelevation Report	Microsoft Edge HTML Do...	1 KB
	KY 245.alg	ALG File	53 KB
	KY245.ird	IRD File	203 KB
	KY245.itl	ITL File	162 KB
	Proposed DTM	Microsoft Edge HTML Do...	1,549 KB
	Proposed DTM.dtm	DTM File	5,021 KB

Contract Letting Information
INDOT

Posted Documents for View and Download

Search Criteria

- Document Type: All
- Contract Number: 41542
- District: Not Selected
- Letting Date Month: Not Selected
- Letting Date Year: Not Selected

Document Types Available:

- Pre-Letting Documents:
 - Contract Information Books
 - Revisions
 - Plan/Drawing Sets
 - Existing Plans
 - Permits
 - Additional Reports
 - Q And A Forms
 - Geotech Reports
 - Utilities Information
 - Additional Information
 - Project Commitments
- Post-Letting Documents:
 - Construction Changes

Results Found:

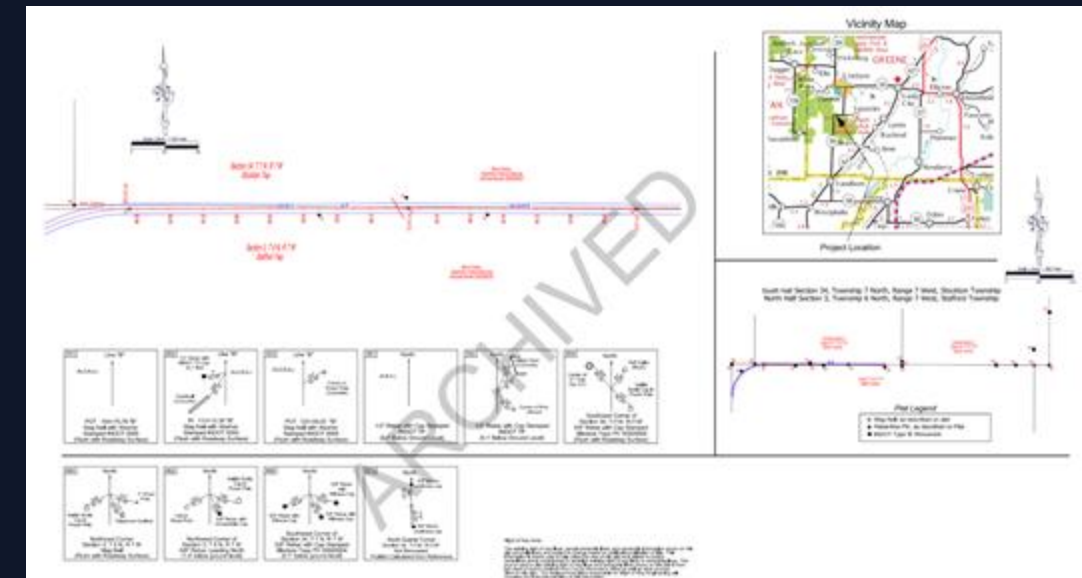
[Begin a New Search](#)

Expand All Collapse All

Document Type	Number of Records
Contract Information Books	1
Plan/Drawing Sets	69
Existing Plans	9
Revisions	3
Q And A Forms	1
Permits	6
Reports	32
Utilities Information & Right of Way	42
Project Commitments	1
Additional Information	1
Construction Changes	247
Proposals	2

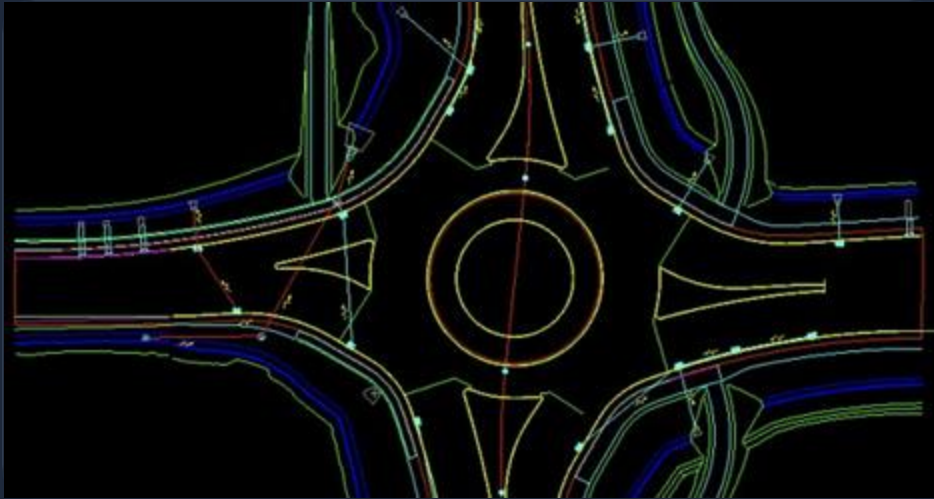
Select File	Contract Number	Title	Content Id	Final Tracing Type	Design Type	Document Type	District	Letting Date	Primary Designation Number	Last Updated On	File Size in KB's
Select File	R 41542	FT PrebidMeeting 0500432 For Contract Services	UCM11GDOTS897469		NON-IPOC CONSULTANT	Additional Information	Seymour	11/18/20		1/18/23	3484

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THEORY VS. REALITY

THE CLEAN CAD MODEL



Perfect geometry, zero obstructions, clear sightlines.

THE JOB SITE



Adjacent projects, fiber lines, and phasing impacts.

| OUR ROLE: THE BRIDGE



MODEL REFINEMENT

We "densify" design data to improve surface smoothness.



STAGING MODELS

We build models for the phases
between existing and finish
grade.



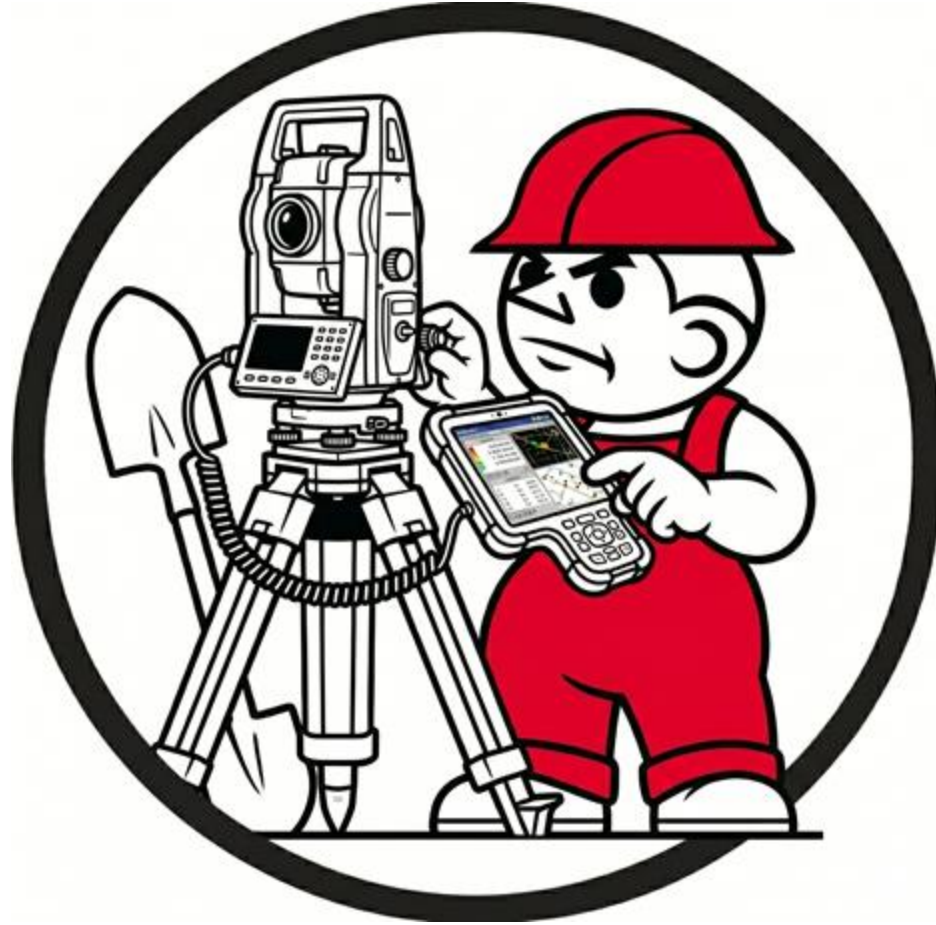
FIELD FEEDBACK

Translating surveyor data back
into usable engineering revisions.

“

*"We don't build the design; we build
the reality that the design attempted
to predict."*

- Tony Lusk



QUESTIONS?