MDOT Survey Support

Construction Engineering

Automated Machine Guidance

Construction Survey Support?

- Located downtown Lansing
- Provide Statewide Support for Construction
  - Equipment Training
    - GPS
    - Total Station
    - Levels
    - Back up equipment
- Provide support for review of AMG workplans and model review.
- Assisting CFS in setting standards for Digital Calculations

How is AMG Utilized?

The contractor utilizes 3D design data rather than field staking to construct project elements such as:

- Rough grading of earthwork
- Final grading of earthwork
- Final grading of Aggregate base
- Finish paving of Concrete and Bit

MDOT Special Provision for AMG

- The Contractor may elect to utilize automated machine guidance (AMG) to determine three-dimensional locations for earth work activities and material placement.

12SP-824A-03

MICHIGAN
DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION
FOR
AUTOMATED MACHINE GUIDANCE

DES:DJB 1 of 3 APPR:DMG:MB:08-03-17
FHWA:APPR:08-09-17

a. Description. The Contractor may elect to utilize automated machine guidance (AMG) to determine three-dimensional locations for earth work activities and material placement. AMG is the process of automatically adjusting the motion of a machine with an onboard computer that obtains its position from global positioning systems, robotic total stations, lasers, or combinations of similar methods while referencing the Contractor's model developed for the project. This procedure can be used in operations such as earth excavation, material placement, grading, trimming, and/or paving.

1. AMG Intent

The Contractor will notify the Engineer of the intent to use AMG within 10 calendar days of the Award.

2. Work Plan

C. **Slope Stakes, Subgrade Stakes, Undercut Stakes, Clearing Stakes.** Provide slope stakes, subgrade stakes, undercut stakes and clearing stakes at 50-foot intervals or as agreed by the Engineer, and at break points due to subgrade transitions, including superelevation transitions and ramp transitions. The Engineer may request subgrade stakes for subgrade inspection, after topsoil stripping and before beginning subsequent grading operations. The Engineer will mark and determine individual tree removal.

D. **Pavement Stakes.** After placing and rough grading the subbase, provide pavement stakes as follows:

1. Place stakes at 50-foot intervals on tangent sections and on curves with radii of at least 1,150 feet.
2. Place stakes at 25-foot intervals on curves with radii of less than 1,150 feet.
3. In addition to yield stakes, set stakes to determine wedging limits for hot mix asphalt pavement. This may include taking cross sections in questionable areas, as determined by the Engineer.

Use pavement grade stakes for finish grading of the subbase, base course, and pavement. Check stakes for grade, realign, and tack before beginning paving operations. Determine the offsets required for Contractor operations and obtain the Engineer's approval.

AMG WORK PLAN

COMPANY SUBMITTING FORM: ABC Construction, Inc.
JOB NUMBER: 112877, CONTROL SECTION: 47064
PROJECT LOCATION: I-96 and US-23 Interchange

ITEMS OF WORK

IDENTIFY THE ITEMS OF WORK COVERED IN 824.03C, AND 824.03D OF THE STANDARD SPECIFICATIONS FOR CONSTRUCTION. SPECIFY THE LOCATIONS WHERE EACH AMG PROCEDURE WILL BE EMPLOYED & SUMMARIZE THE PROPOSED AMG PROCEDURE(S) THAT WILL BE UTILIZED TO COVER EACH ITEM OF WORK. ALSO, IDENTIFY THE ANTICIPATED ACCURACY OF EACH OPERATION.

- **Clearing Stakes** – A bulldozer fitted with GPS will be used to clear the brush from the side slopes of the roadway. This equipment will be able to achieve a positional tolerance within 1'. This will be employed in any areas that require clearing from the POB to POE of the project.
- **Slope Stakes**– A bulldozer fitted with GPS will be used to grade the slopes and the ditch areas of the roadway. This equipment will be able to achieve a positional tolerance within 0.10'. This procedure will be employed for all slope grading from station 124+00 to 295+50 except for the 500' section obstructed by the overpass at 132+00 to 137+00. Conventional stakeout will be required in this area.
- **Subgrade Stakes and Undercut Stakes** – A bulldozer and wheeled grader fitted with GPS will be used to grade the roadway to clay grade. Then the same equipment will be used to place the stone. This equipment will be able to achieve a positional tolerance within 0.08'. After the stone is placed and rough graded a trimming machine will be used to trim the stone to the final grade. This equipment is guided by total stations and is capable of achieving a positional tolerance within 0.02'. This procedure will be employed from the POB to POE on both bounds. Additional control will be required to support this operation – see "Control."
- **Pavement Stakes** – A GOAMCO concrete paving machine will be used to place the concrete on the project. This equipment is guided by total stations and is capable of achieving a positional tolerance within 0.02'. This will be employed from POB to POE on both bounds. Additional control will be required to support this operation – see "Control."

ERIENCE

VIDE A BRIEF SUMMARY OF YOUR PAST EXPERIENCE WITH AMG OPERATIONS. LIST IFIC PROJECTS IF APPLICABLE.

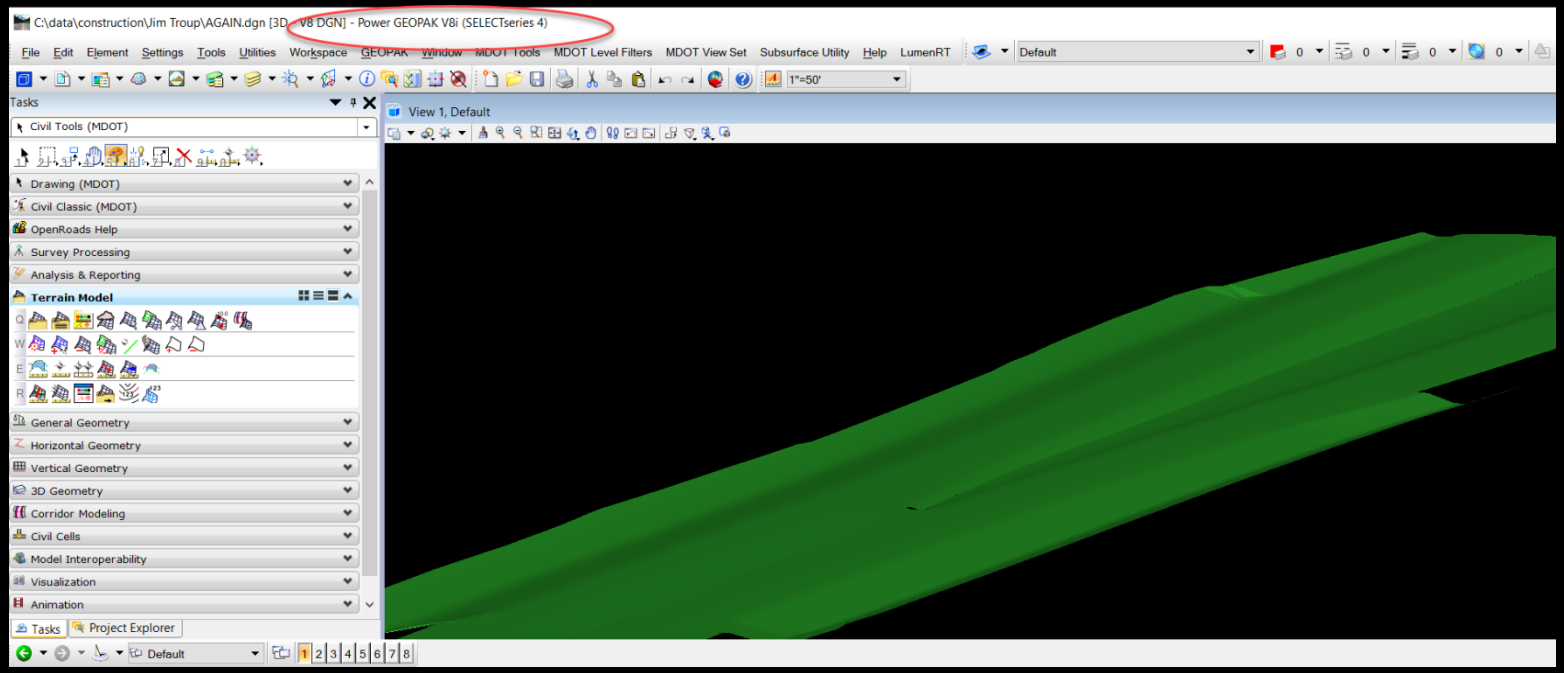
onstruction, Inc. has been using AMG equipment for the past 7 years on various projects throughout the state of n. Most recently ABC utilized AMG operations to reconstruct 8 miles of I-94, from North County Road 365 east nterchange at M-40 and I-94 near Paw Paw, MI.

3. Survey Meeting

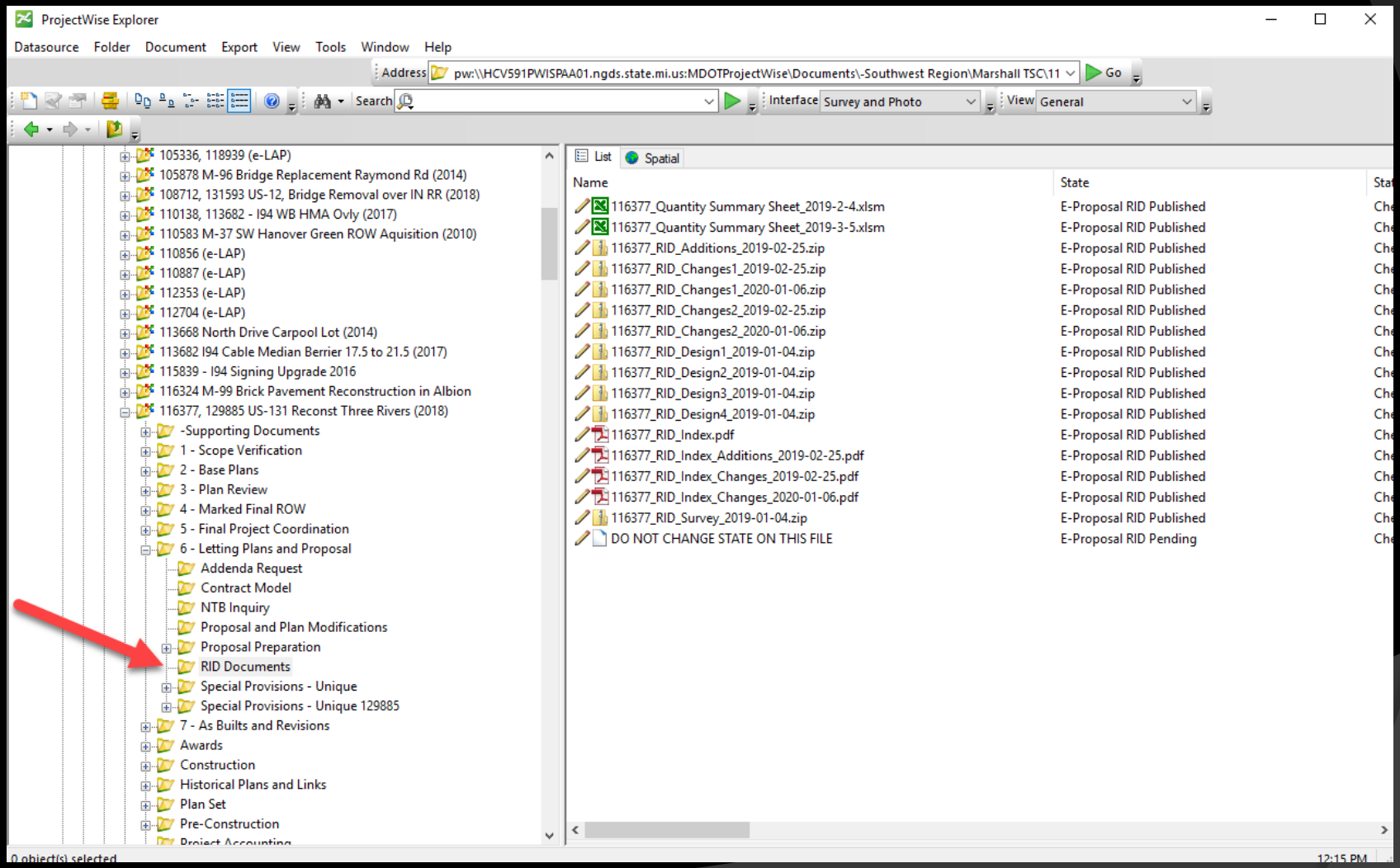
AVOID THIS

BY HAVING THIS

4. Contractor Model



Location of RID Information



Reference Information Documents (RID) Index

RID Folder Contents

- Alignment data
- Construction data
- ROW data
- 3D Surface Data
- Control points

Better by DESIGN MDOT

Michigan Department of Transportation

RID Index

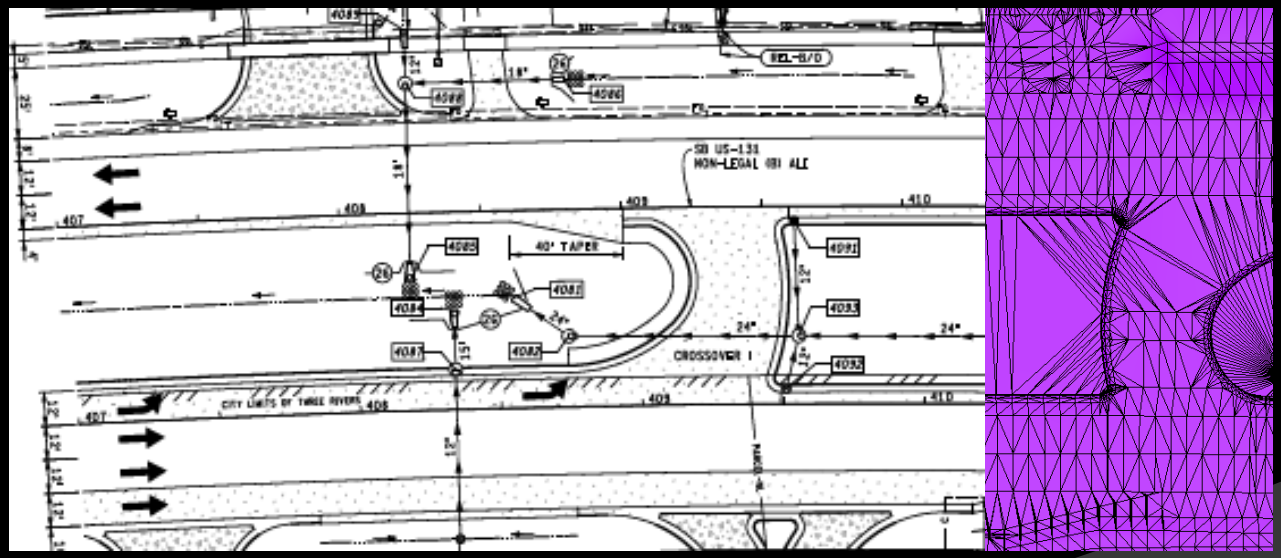
Refer to Chapter 3 in the Design Submittal Requirements for the Standard Naming Conventions

Revision Date: 12/21/2016

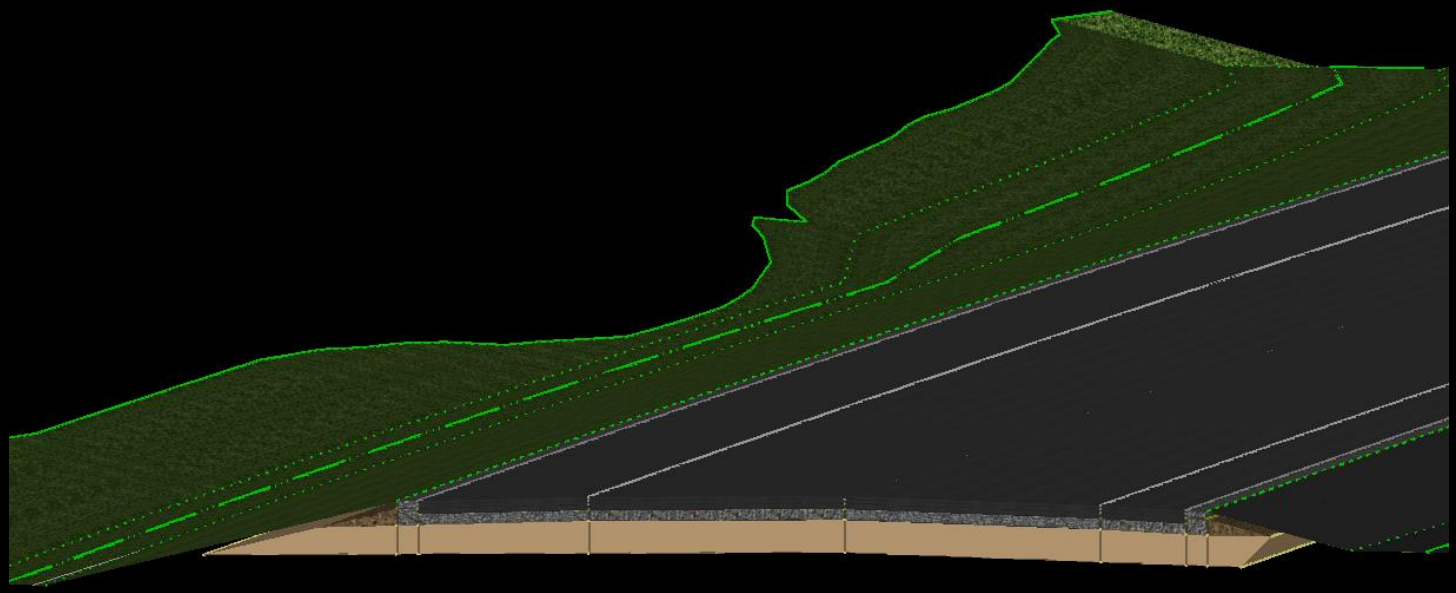
Project Information					
Region:	_Superior_				
TSC:	_Ishpeming				
County:	Houghton				
Control Section:	31013	31031			
Job Number(s):	204089A				
Project Location:	C07 of 31013, M-26 Over Gooseneck Creek Tributary				
Project Description:	BRIDGE - SPECIAL NEEDS				
Design Engineer:					
Design Team:					
Version of Workspace Used:	MDOT02				
Alignment Files (A)	204089_RID_Design_Gooseneck_2018-07-25.zip				
Horizontal Alignment DGN File:	A-204089_Alignment_Gooseneck_2018-07-25.dgn				
Alignment_LandXML File:	A-204089_LandXML_Geometry_Gooseneck_2018-07-25.xml				
Vertical Alignment DGN File:	A-204089_Alignment_Gooseneck_Vertical_2018-07-25.xml				
Design Files (D)	204089_RID_Design_Gooseneck_2018-07-25.zip				
Construction DGN File:	D-204089_Gooseneck_Cons_2018-07-25.dgn				
Existing Topo DGN File:	D-204089_Gooseneck_Topo_2018-07-25.dgn				
GPK File:	job535.gpk				
Environmental (E)	204089_RID_Design_Gooseneck_2018-07-25.zip				
Proposed Environmental DGN File:	E-204089_Environmental_2018-07-25.dgn				
Models (M)	204089_RID_Design_Gooseneck_2018-07-25.zip				
Proposed Roadway Bottom Surface LandXML:	M-204089_LandXML_SubSurf_Gooseneck_2018-07-25				
Proposed Roadway Top Surface LandXML:	M-204089_LandXML_Surf_Gooseneck_2018-07-25				
Proposed Triangles LandXML:	M-204089_LandXML_PrTriangle_Gooseneck_2018-07-25				
Proposed Roadway 3D Corridor:	M-204089_PrCorridor_Gooseneck_2018-07-25				
Proposed 3D Lines (Top Surface):	M-204089_PrLineString_Surf_Gooseneck_2018-07-25				
Proposed 3D Lines (Bot Surface):	M-204089_PrLineString_SubSurf_Gooseneck_2018-07-25				
Proposed Triangles Drawing:	M-204089_PrTriangles_Gooseneck_2018-07-25				
Survey (S)	204089_RID_Survey_Gooseneck_2018-07-25.zip				
Alignment DGN File:	S-204089_Gooseneck_Align_ROW_2018-06-27.dgn				
Alignment LandXML File:	S-204089_Gooseneck_Align_XML_2018-06-25.xml				
Control Points:	S-204089_Gooseneck_ControlPts.txt				
Existing Triangles DGN File:	S-204089_Gooseneck_ExTerrain_2018-06-27.dgn				
Existing Triangles XML File:	S-204089_Gooseneck_ExTerrain_LandXML_2018-06-27.xml				
Existing Survey 2D DGN File:	S-204089_Gooseneck_Survey_2D_2018-06-27.dgn				
Existing Survey 3D DGN File:	S-204089_Gooseneck_Survey_3D_2018-06-27.dgn				
Survey Info Sheet:	S-204089PES_Survey Info Sheet_2018-06-27_Gooseneck_REV_LMT_7-17-18				
Parcel Lines	S-204089_Gooseneck_Property_2018-06-27.dgn				
Cross-Sections (X)	204089_RID_Design_Gooseneck_2018-07-25.zip				
Cross Section DGN File:	X-204089_Gooseneck_XS_2018-07-25.dgn				

Creating Quality 3D Models

- Part of the RID review process is to make sure the RID files are consistent with the Contract Plans



RID Model



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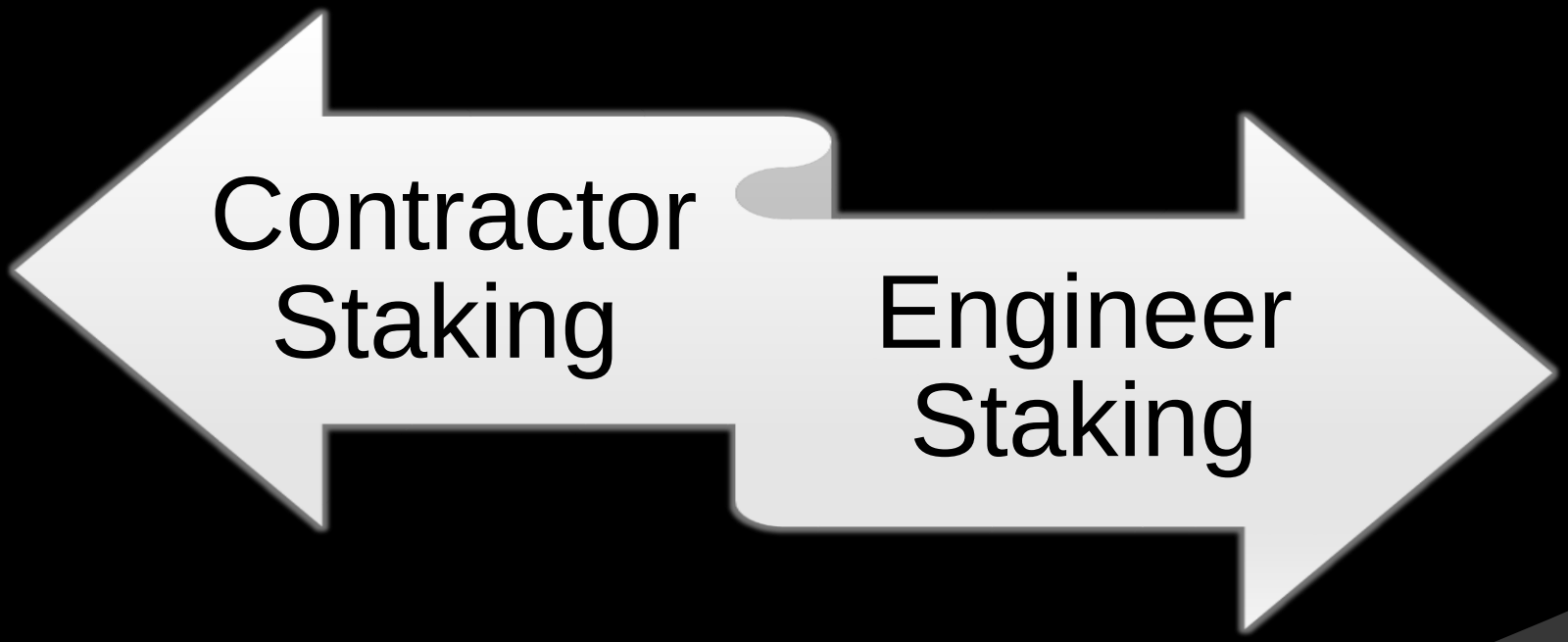
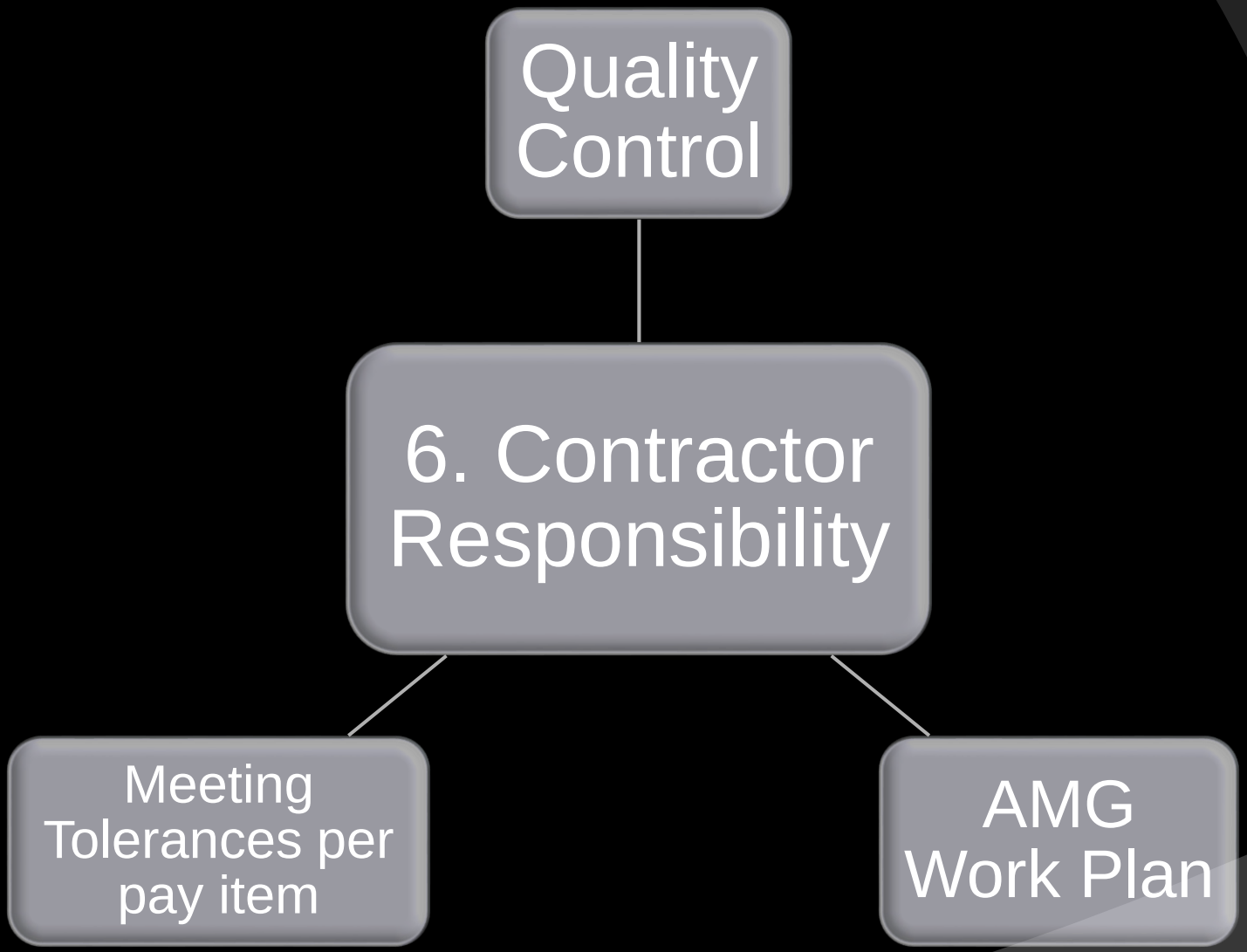



Quality Control
6. Contractor Responsibility
Meeting Tolerances per pay item
AMG Work Plan

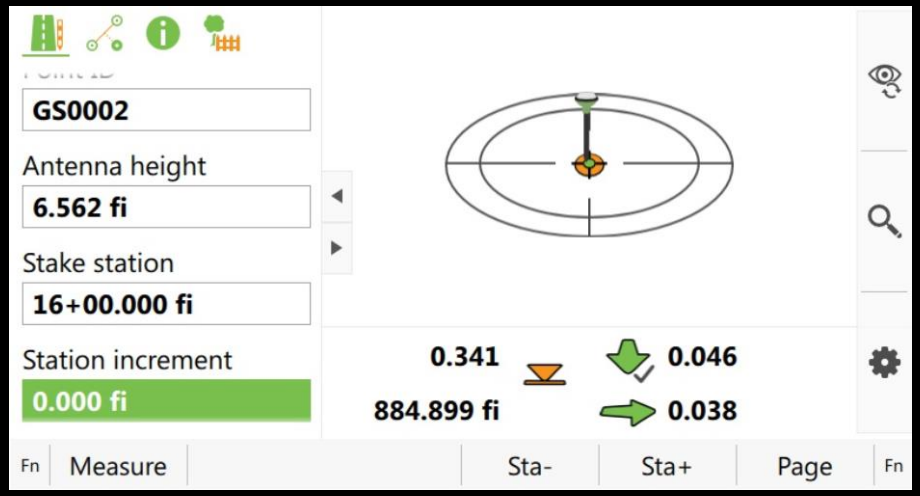
7. Quality Assurance

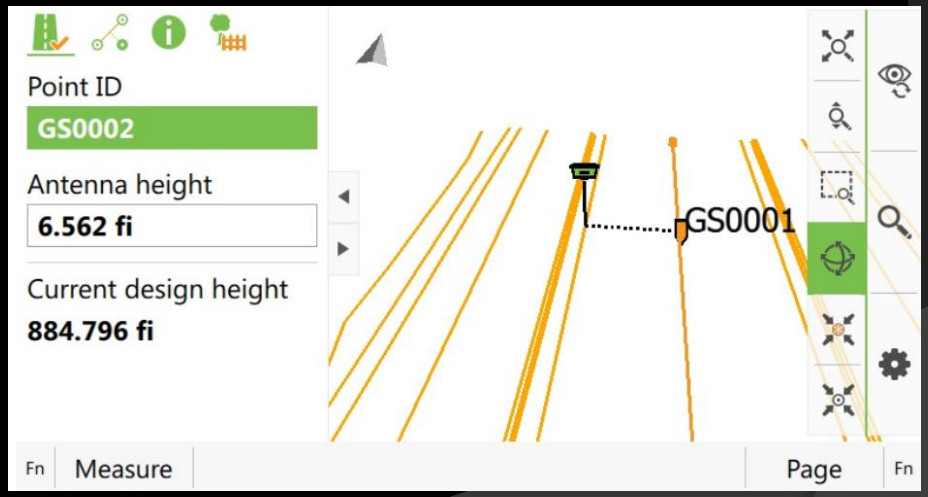
- The MDOT Engineer has options
  - Consultant Surveyor under direct employment of MDOT
  - MDOT staff with Assistance from Lansing Survey Support or the MDOT Region Surveyor.

How do we assure quality?

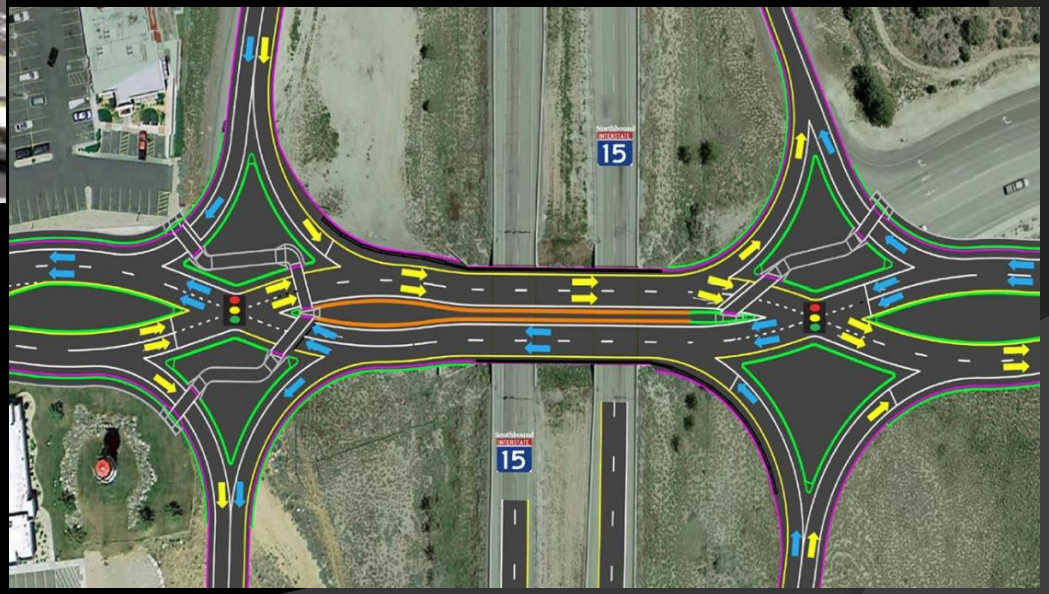
Equipment & Training

Leica Captivate Grade checks

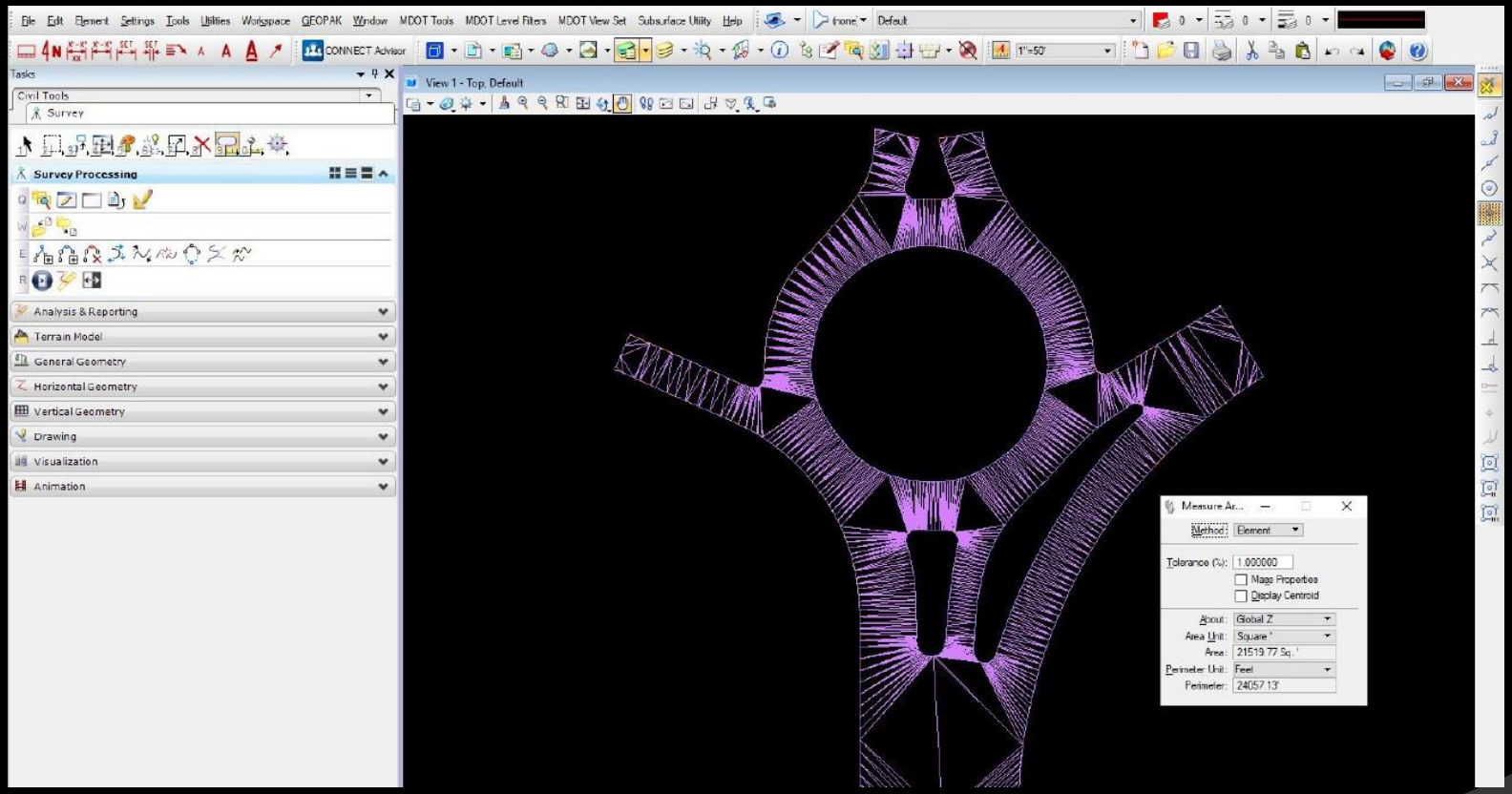




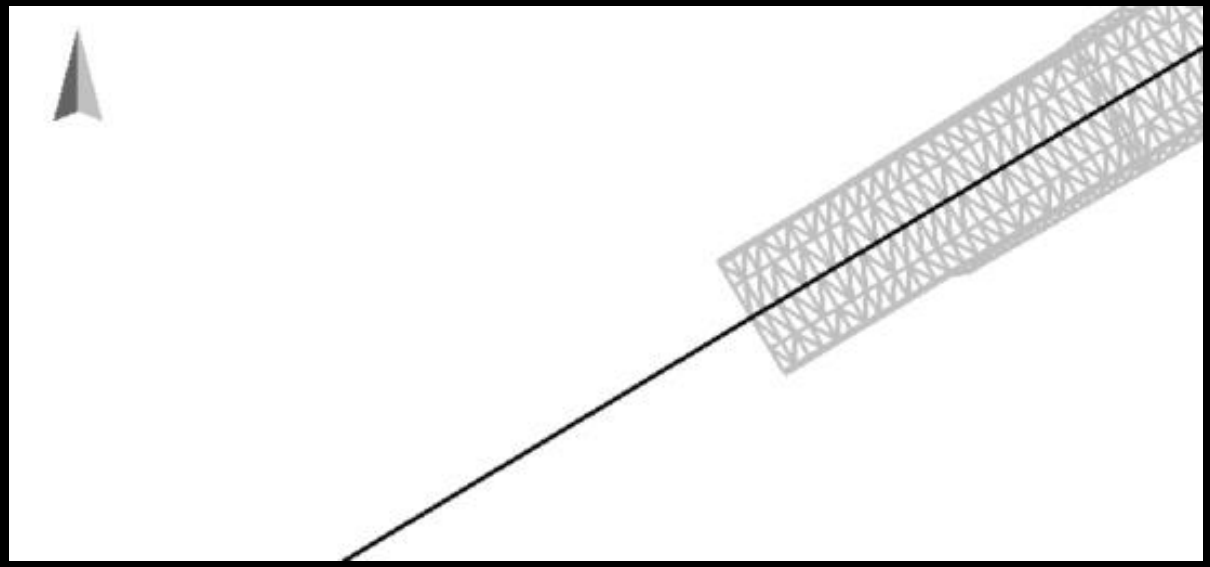
Complex Calculations



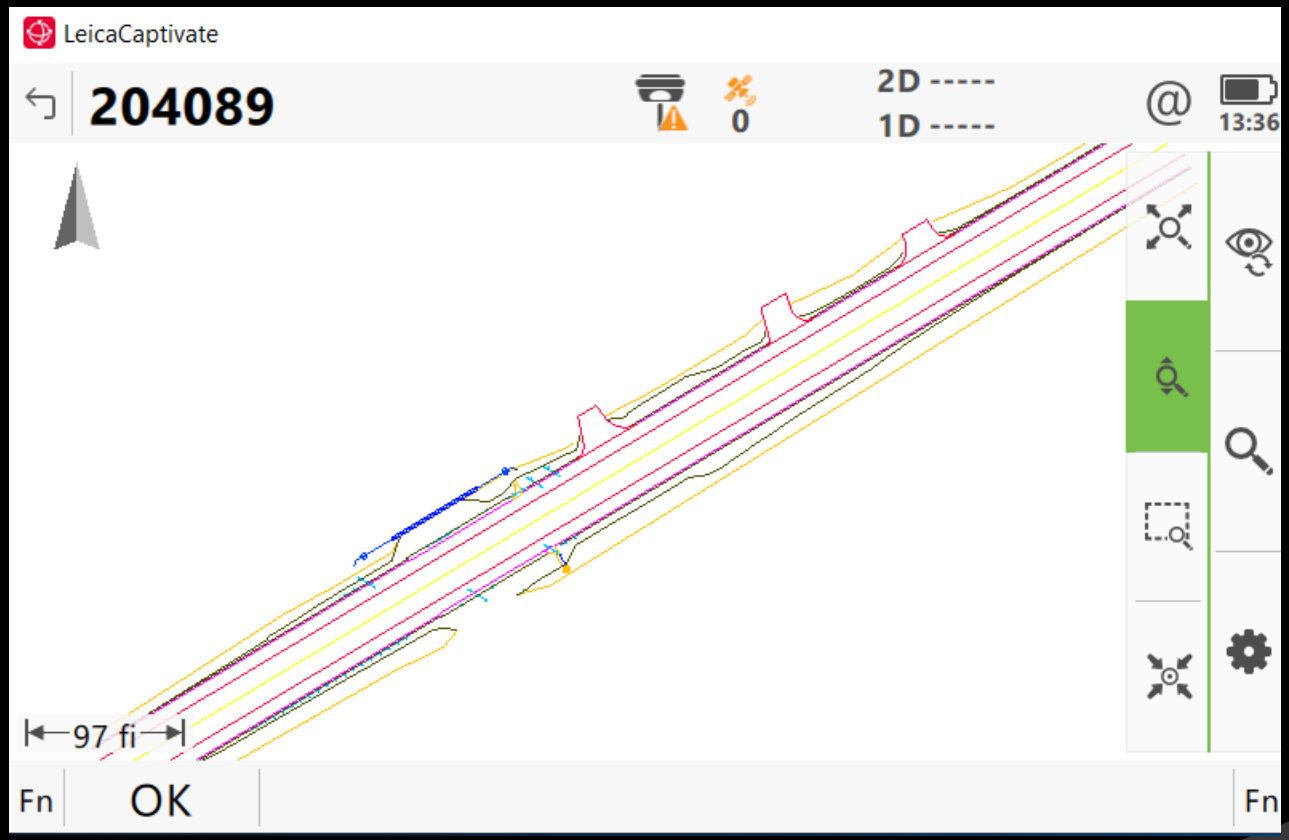
Digital Calculations



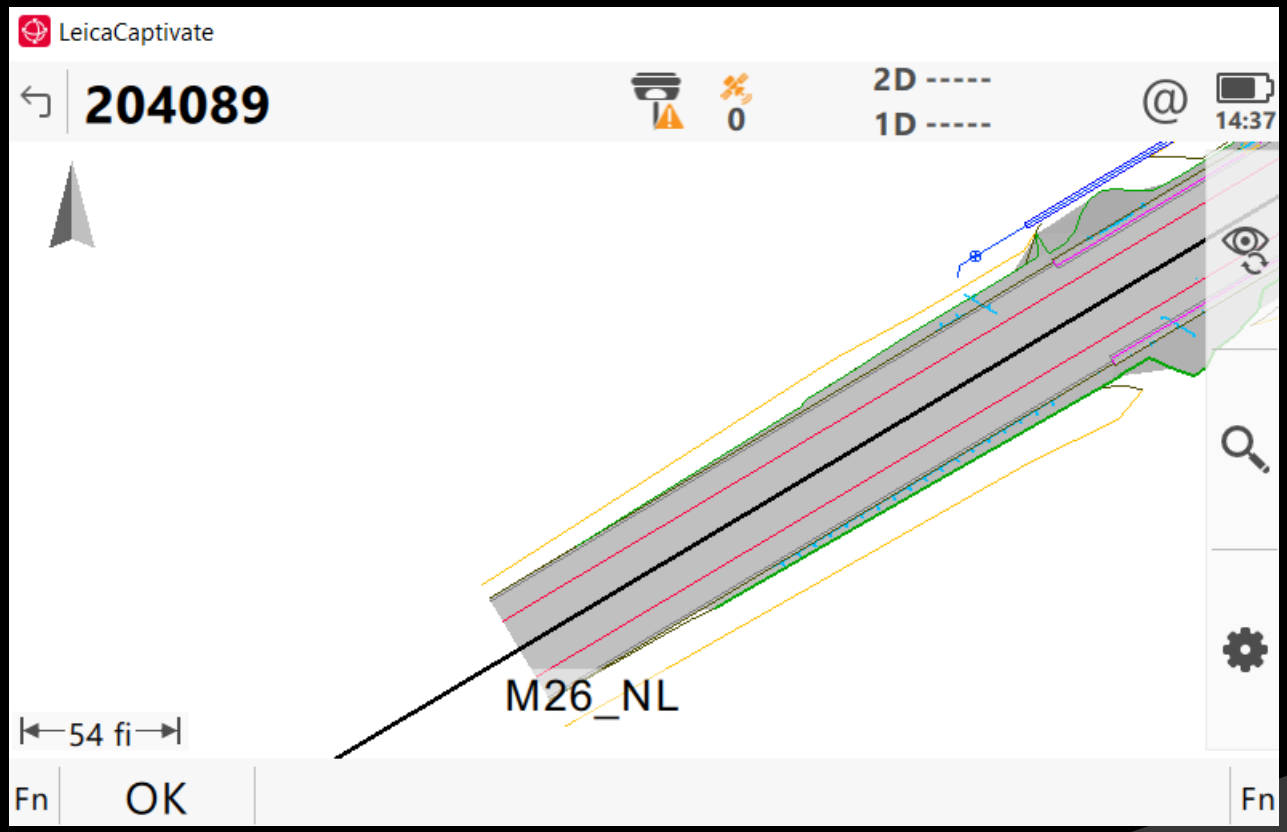
Contractors model



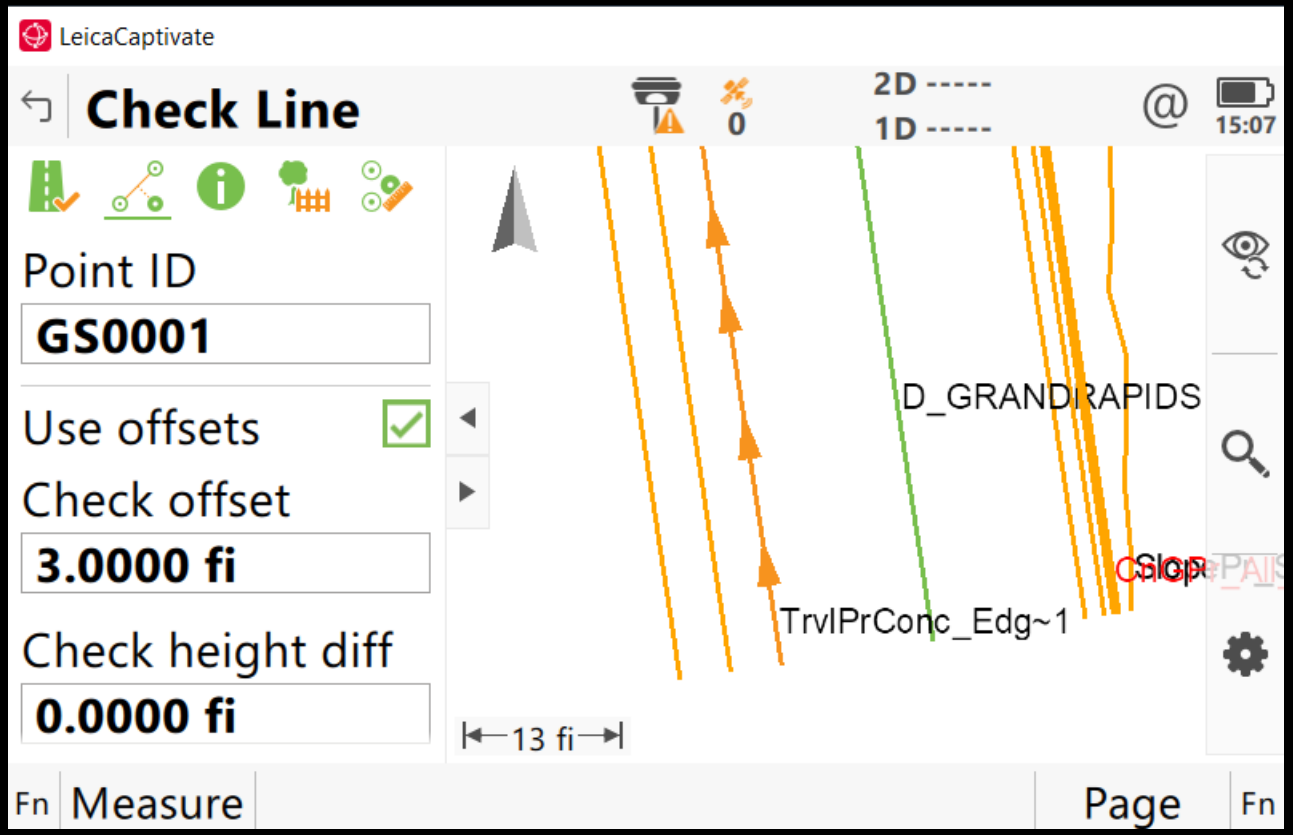
Construction Drawing



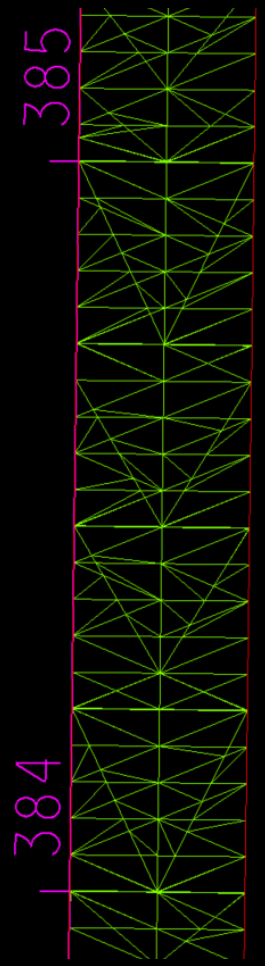
Construction Drawing with Contractors Surface Model

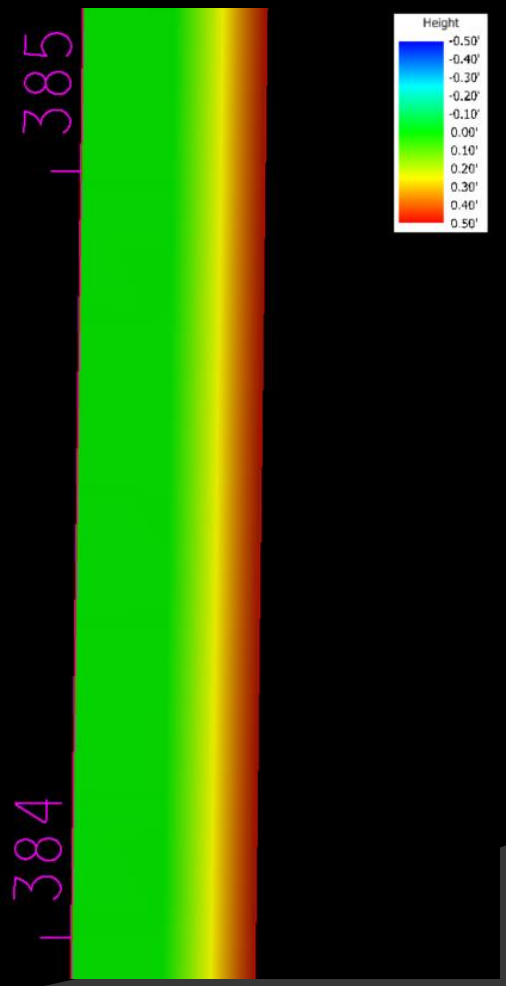


3D Line Strings

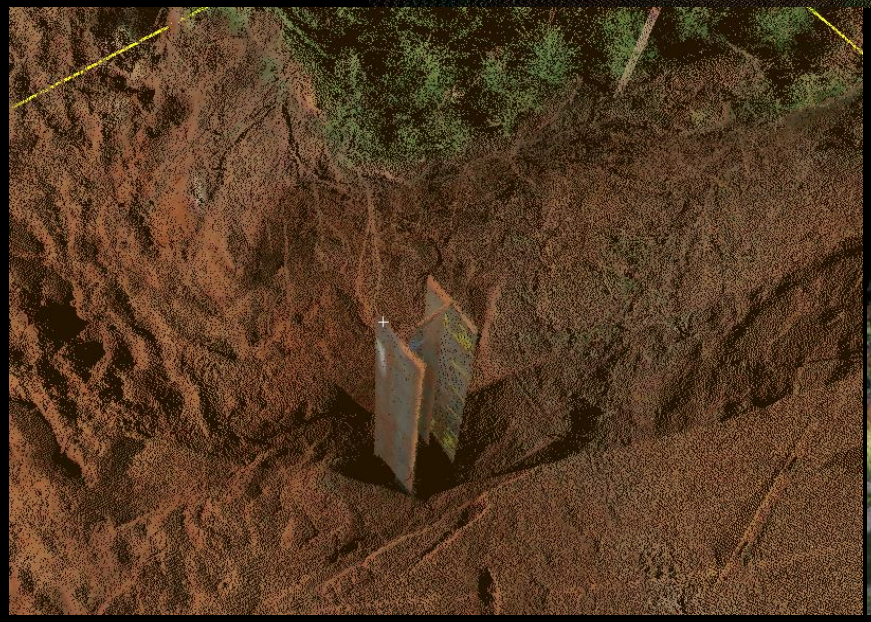


Delta Surfaces





Georeferenced PDF files



THANK YOU