

Road Rehabilitation Made Easy

Tomas Lendvorsky, Peter Ingels

Senior Technical Specialists - AEC





About the speakers

Tomas Lendvorsky

Tomáš joined Autodesk, 13 years ago and currently is working as Senior Technical Specialist, responsible for AEC Autodesk solution in Eastern Europe. Tomas has a master's degree in land surveying. In his current role he is promoting Autodesk BIM solution.



About the speakers

Peter Ingels

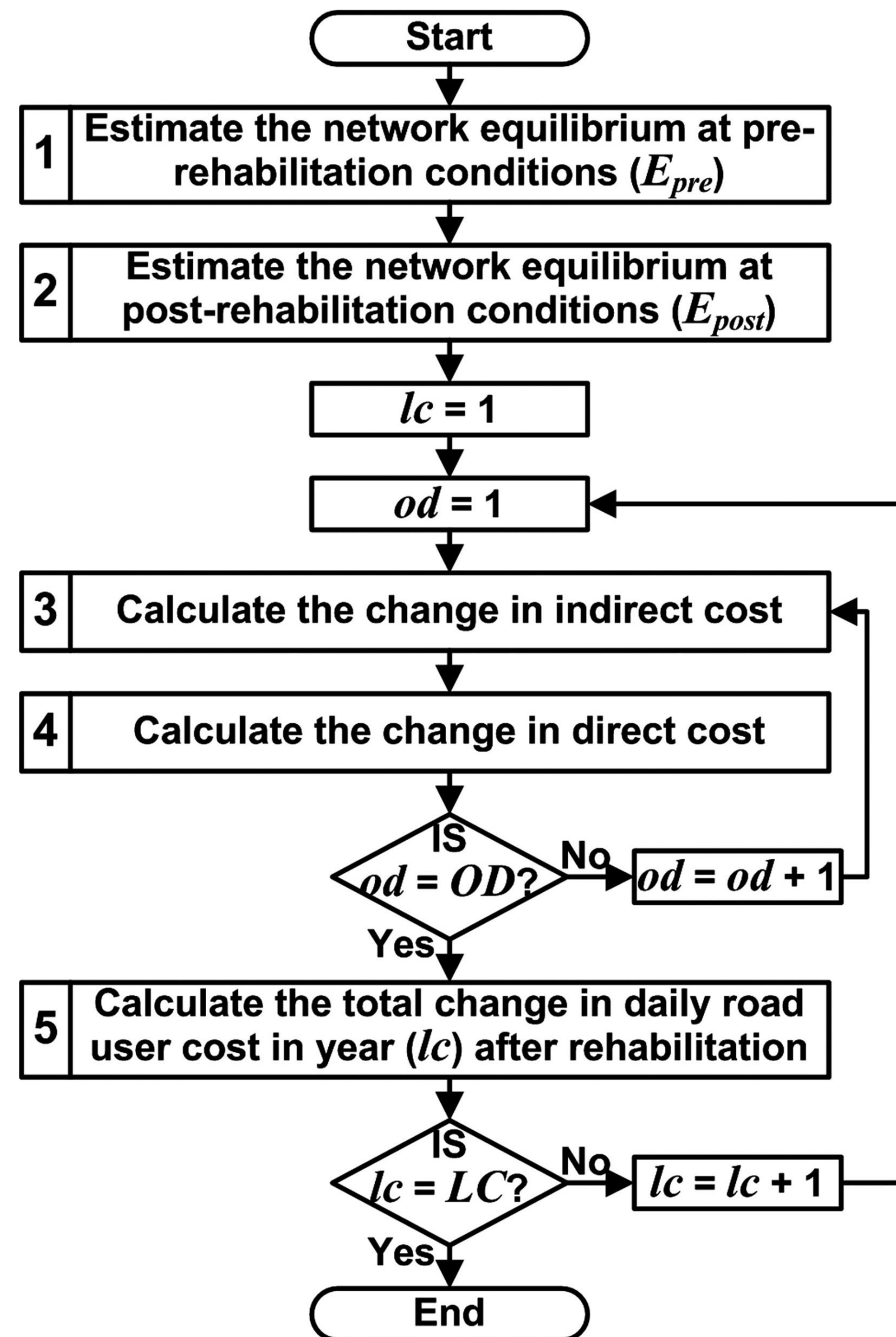
Senior Technical Specialist focusing on Autodesk, Inc.'s, Civil Engineering and Infrastructure Solutions. With a background in engineering and surveying, and over 15 years' experience implementing Autodesk solutions, I'm well positioned to advise on Autodesk's Building Information Modeling BIM for infrastructure strategy.

Road Rehabilitation

- Very tight budgets.
- Meet standards for:
 - Road type
 - Design speed
 - Pavement structure.
- Too many constrains.
- Designers must constantly prioritize multiple alternatives, their cost and benefit.
- Designers often find 'creative' solutions to meet needs...
- There is no 'typical section' in Roadway Rehabilitation
- CAD SW + Excel +.....



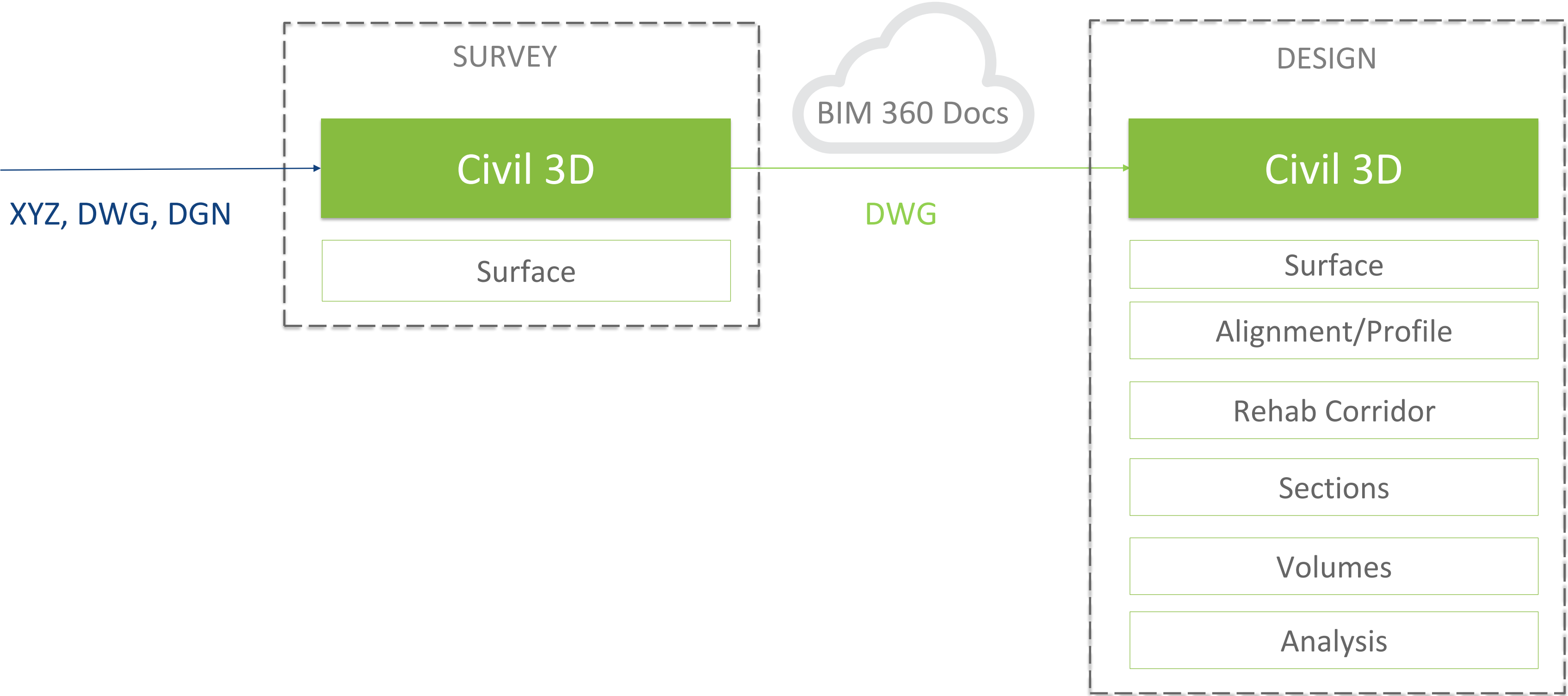
Road Rehabilitation



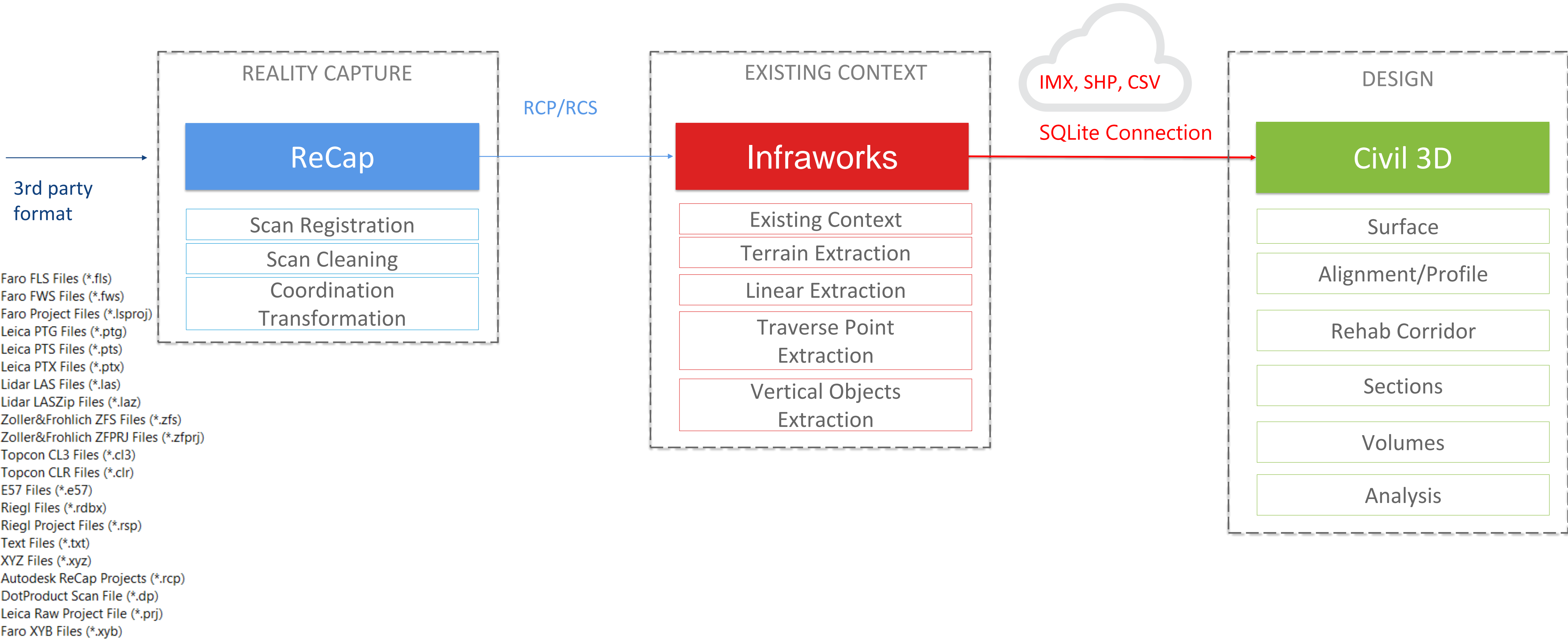
Existing Conditions



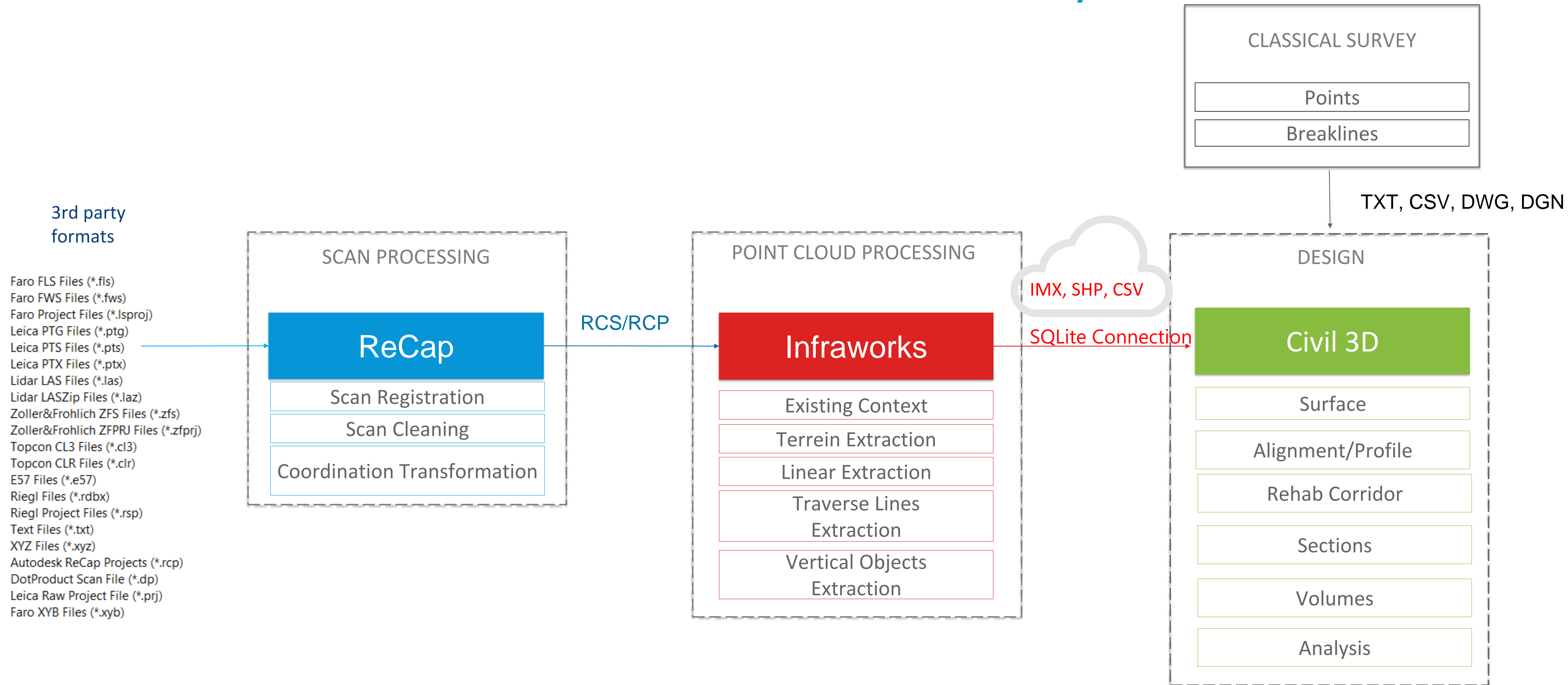
Classical Survey

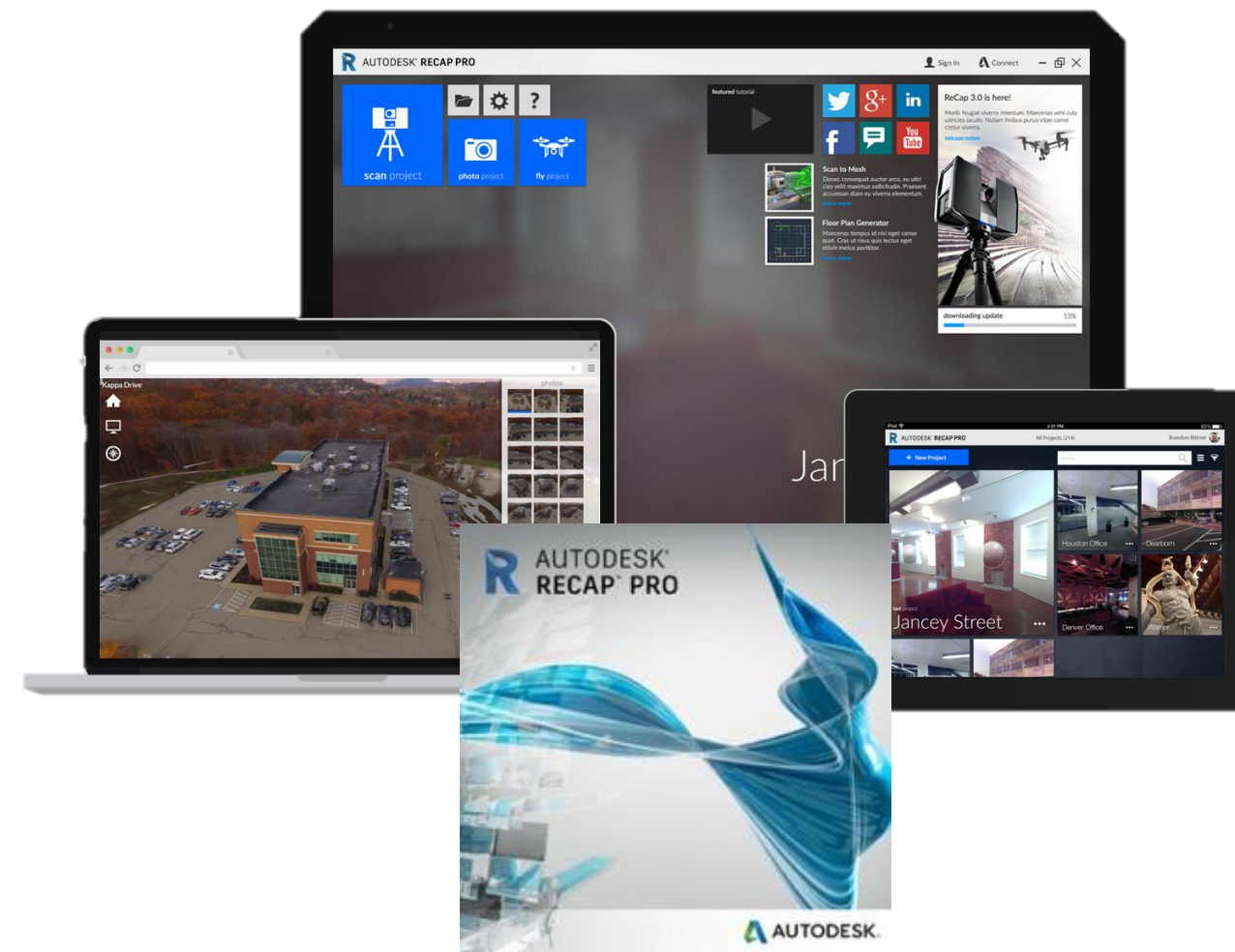


Point Cloud



Point Cloud + Classical Survey





Capture

Compute

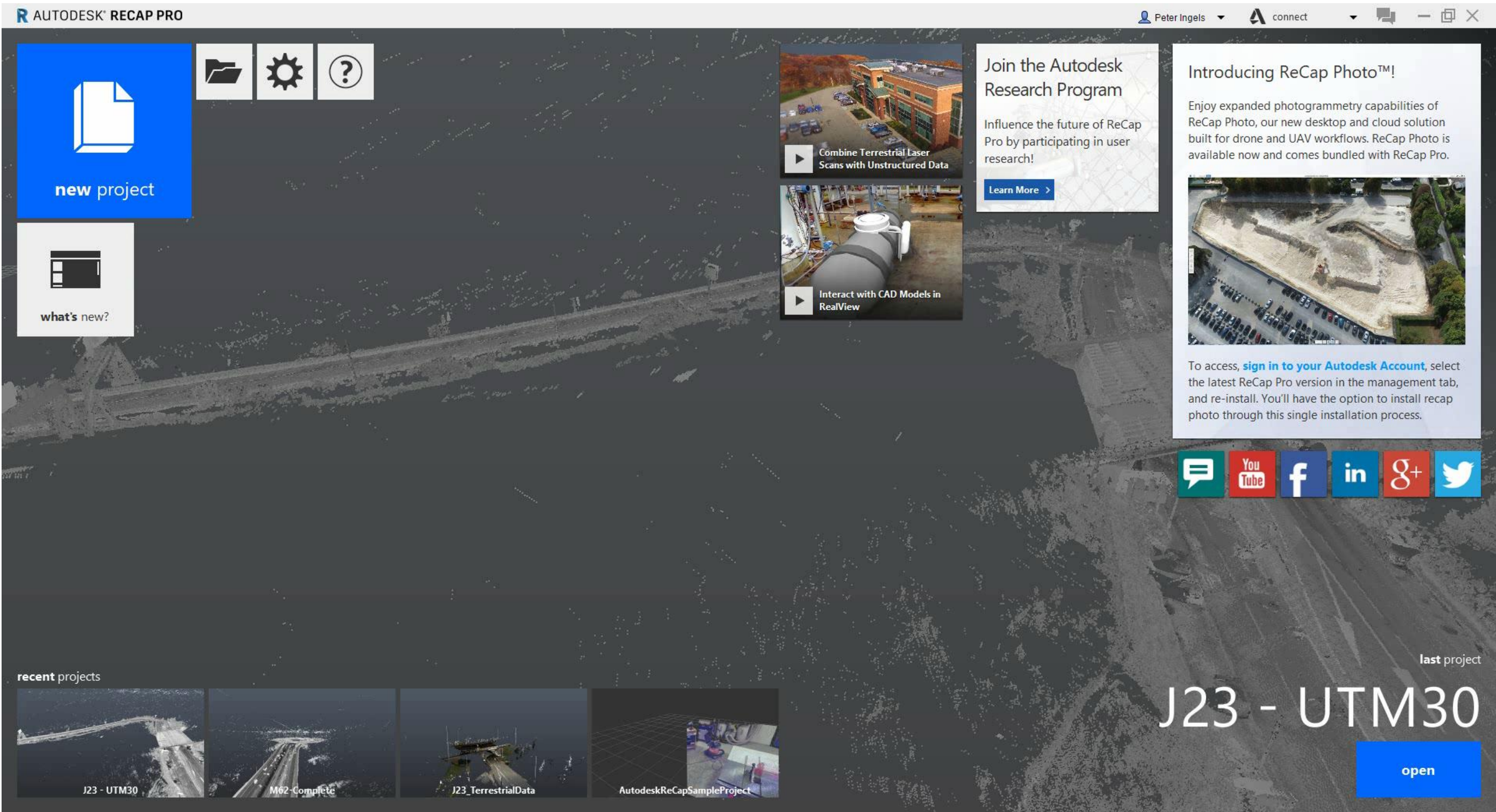
Create

**Photo and
Laser**

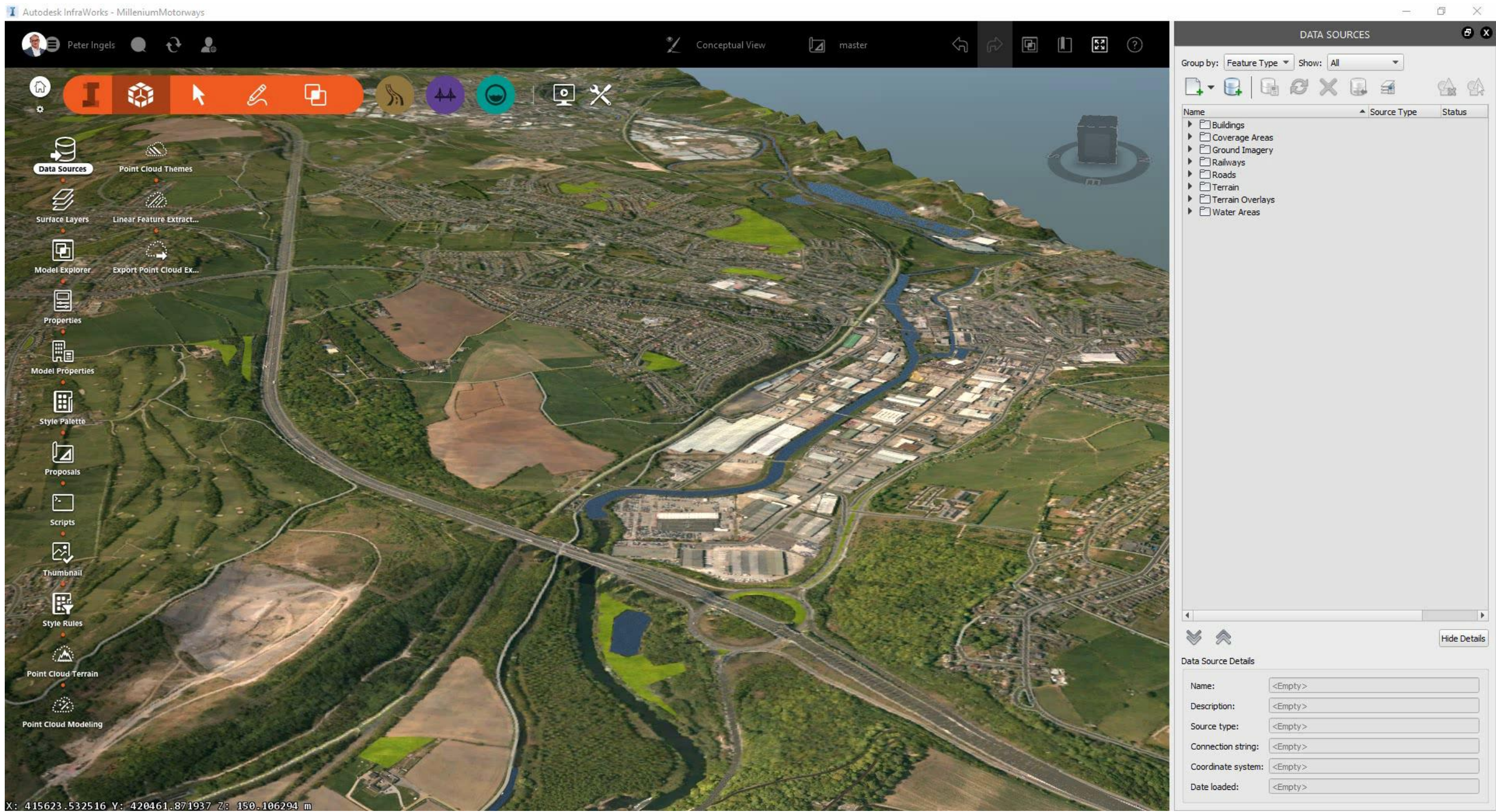
**Automatic scan registration
Intelligent cleanup service**

**Workflow
Integration**

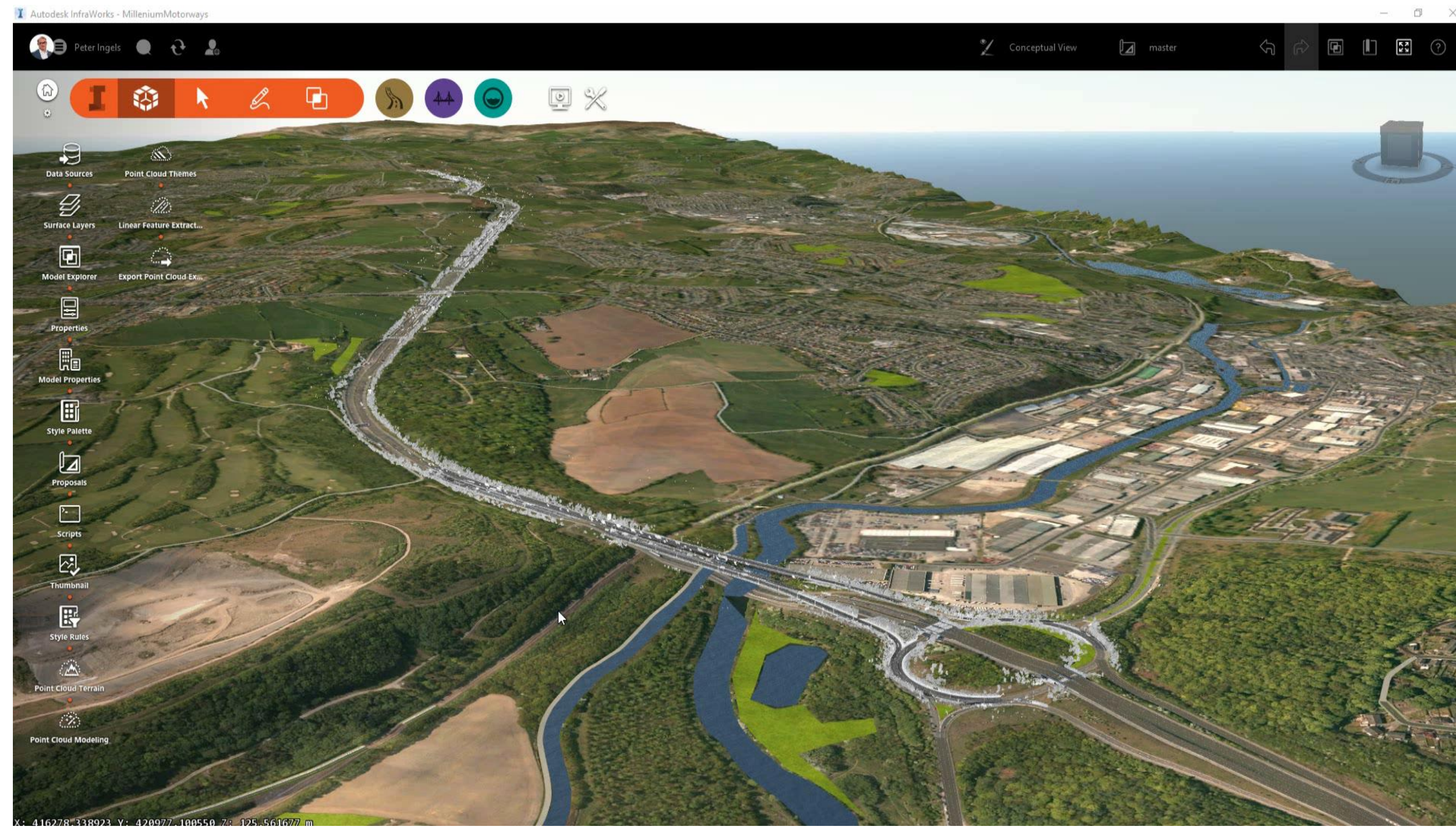
Scan Processing



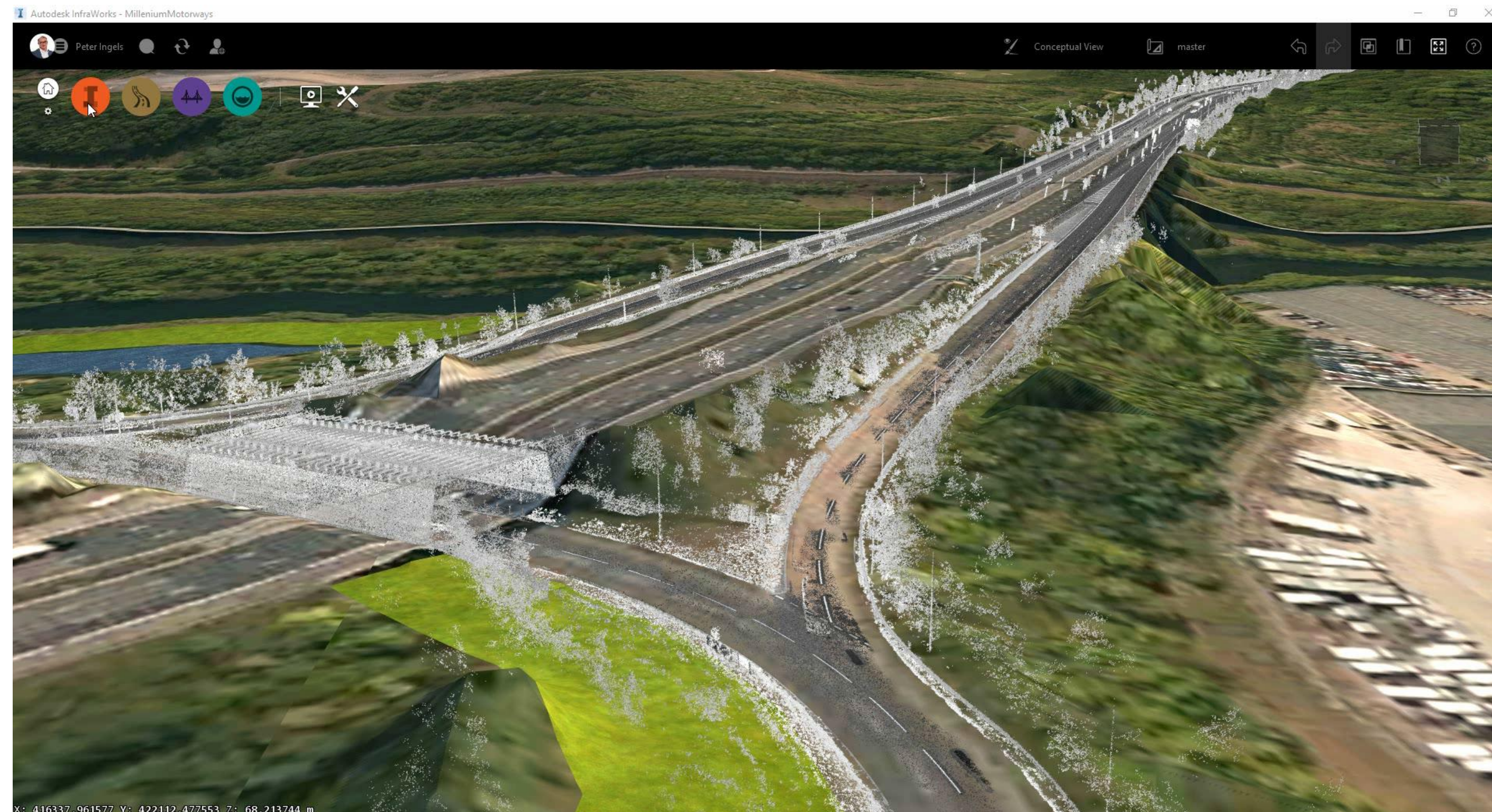
Import Point Cloud



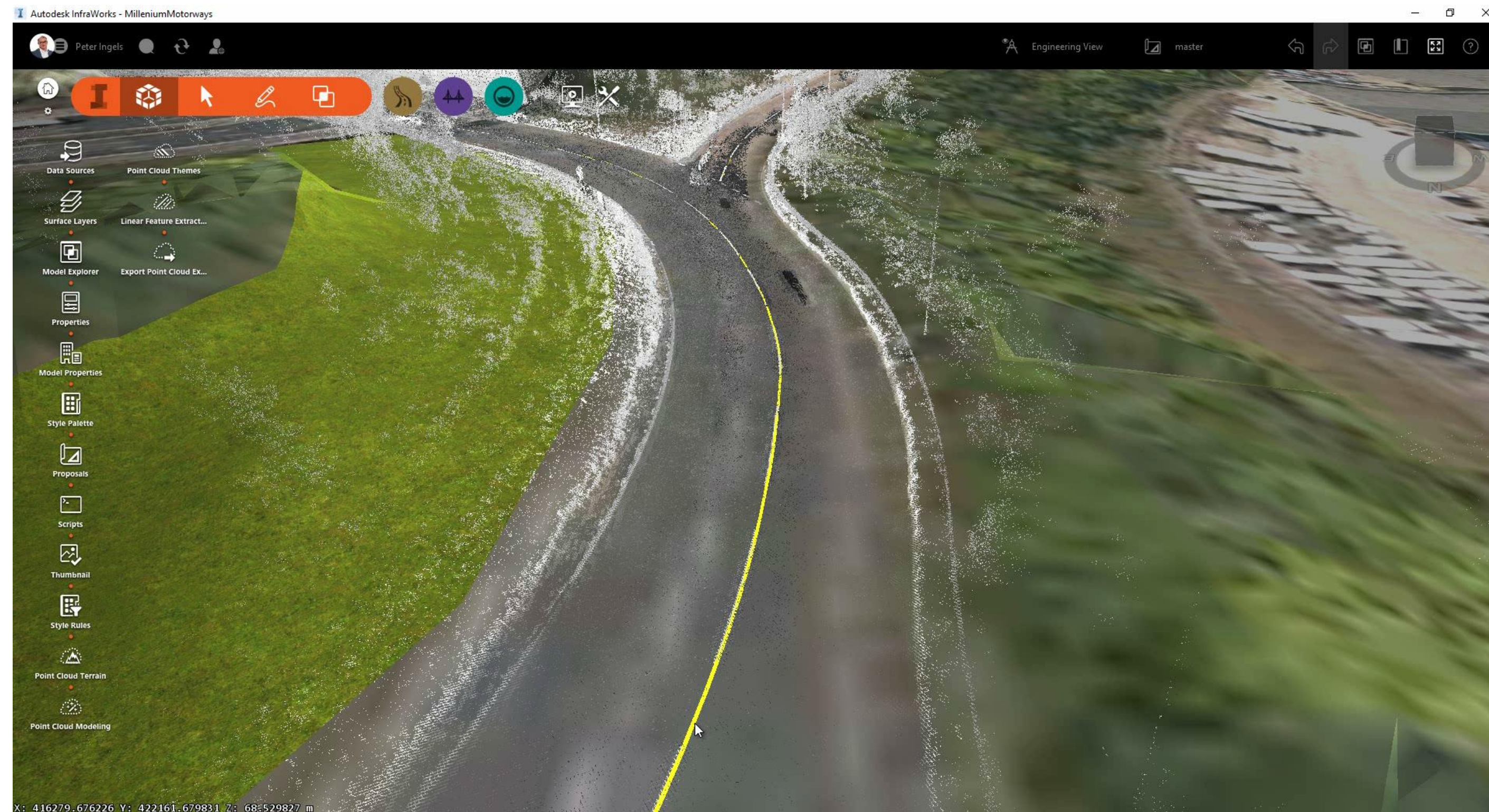
Terrain Extraction



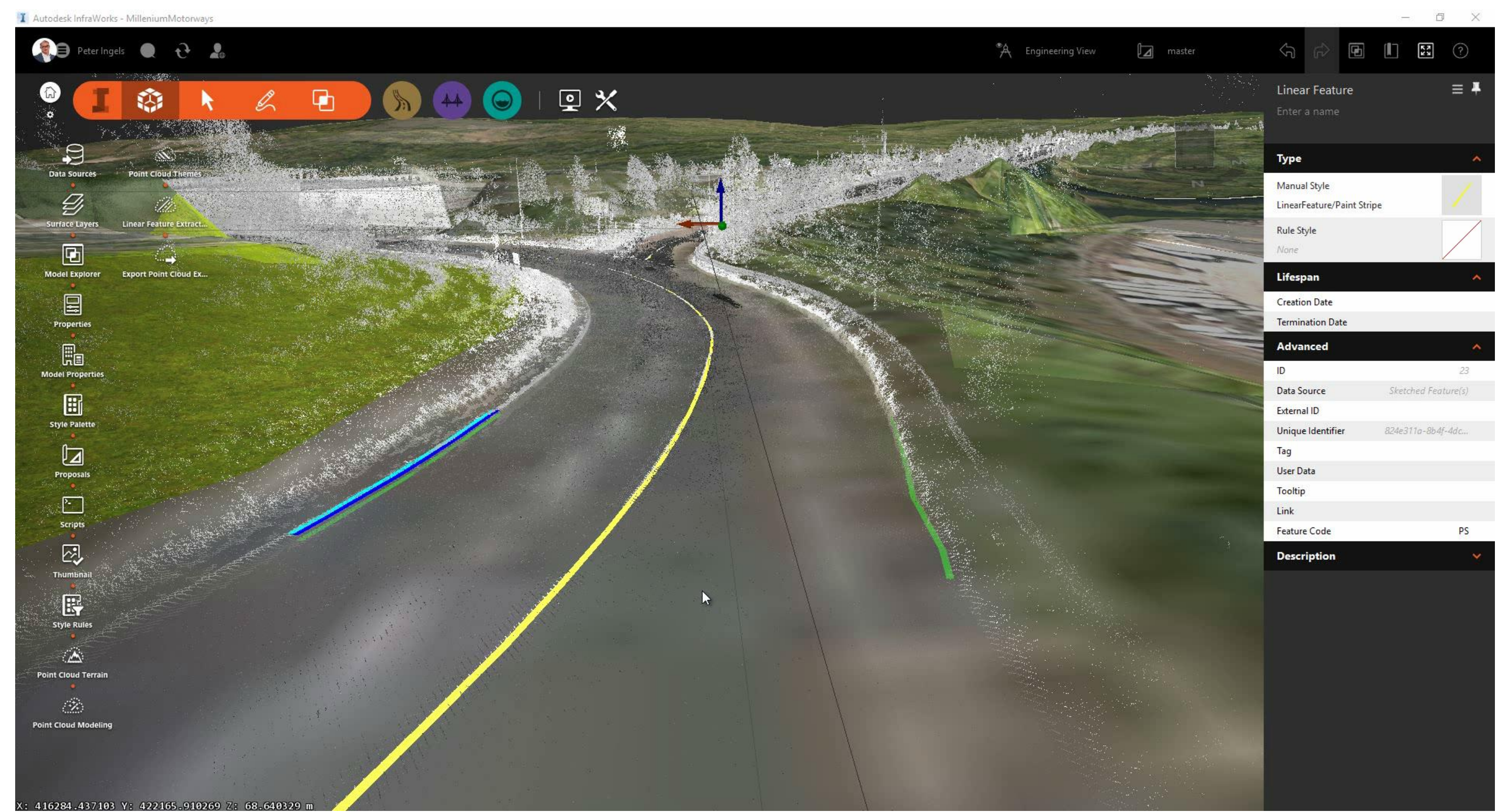
Linear Extraction



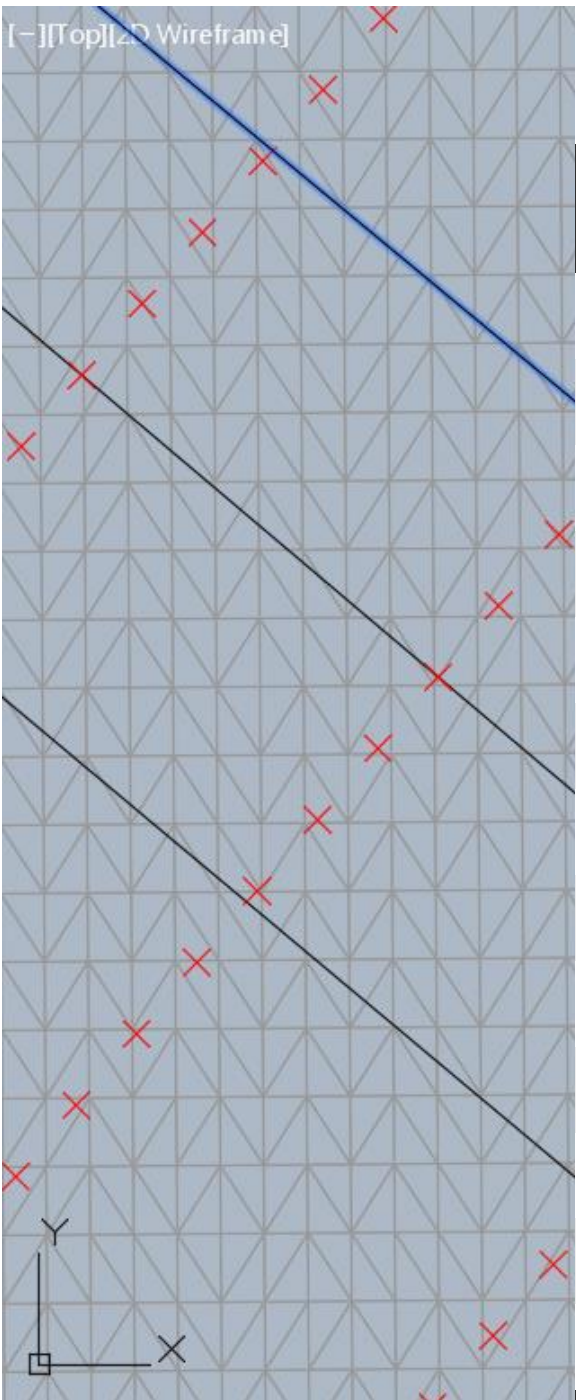
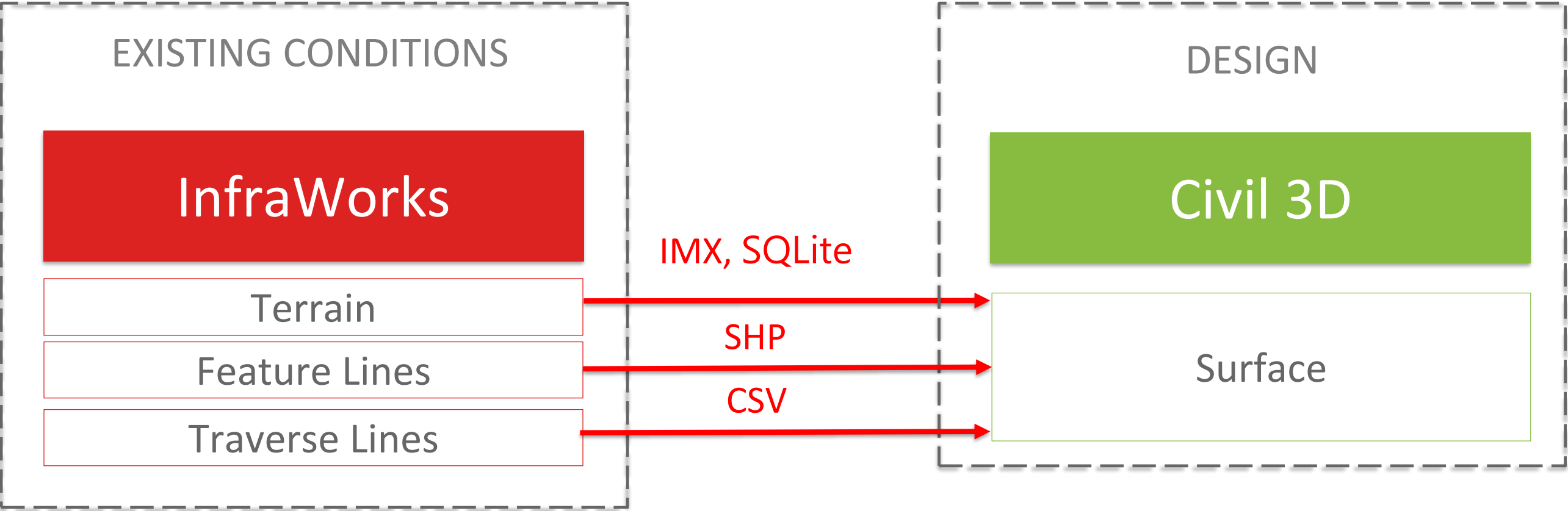
Cross Section Analysis



Traverse Point Creation & Export



Civil 3D Surface model



Point Cloud Terrain

Selected Data Sets

☒ kielcza 170327_group1_densified_point_cloud_part_1

☒ kielcza 170327_group1_densified_point_cloud_part_2

☒ kielcza 170327_group1_densified_point_cloud_part_3

Processing Rules

Ground

Custom

Ground Details

1.000m

Terrain Raster Resolution

2000

Fill Terrain Holes

☐

Processing Window Size

20.000m

Linear Feature

Custom

Feature Resolution

0.100m

Min Allowable Intensity

10

Max Curb Height

0.200m

Min Curb Height

0.080m

Vertical Feature

Custom

Min Points Per Object

100

Feature Size

0.100m

Results Options

Override Model Point Cloud

☐

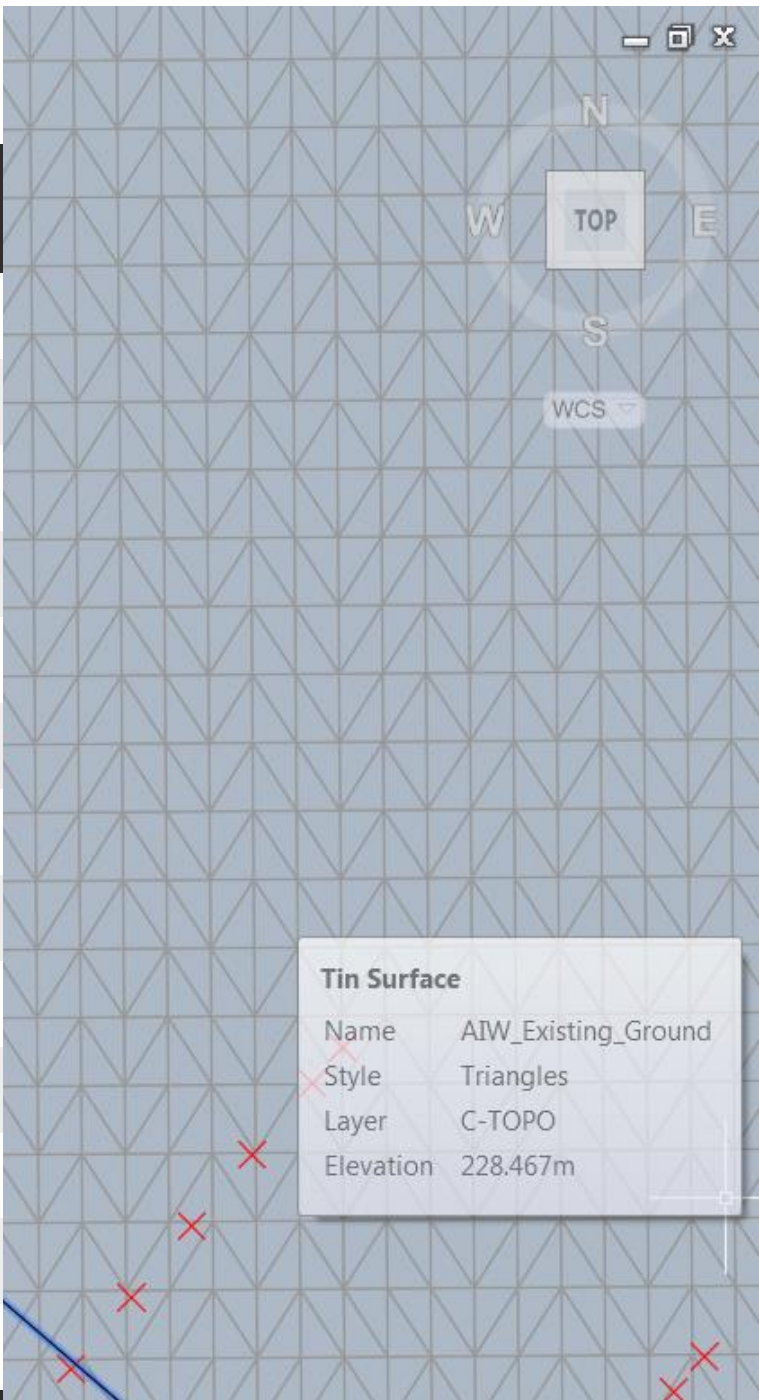
Generate Data

Light Weight

Export Processed File

Do not export

START PROCESSING

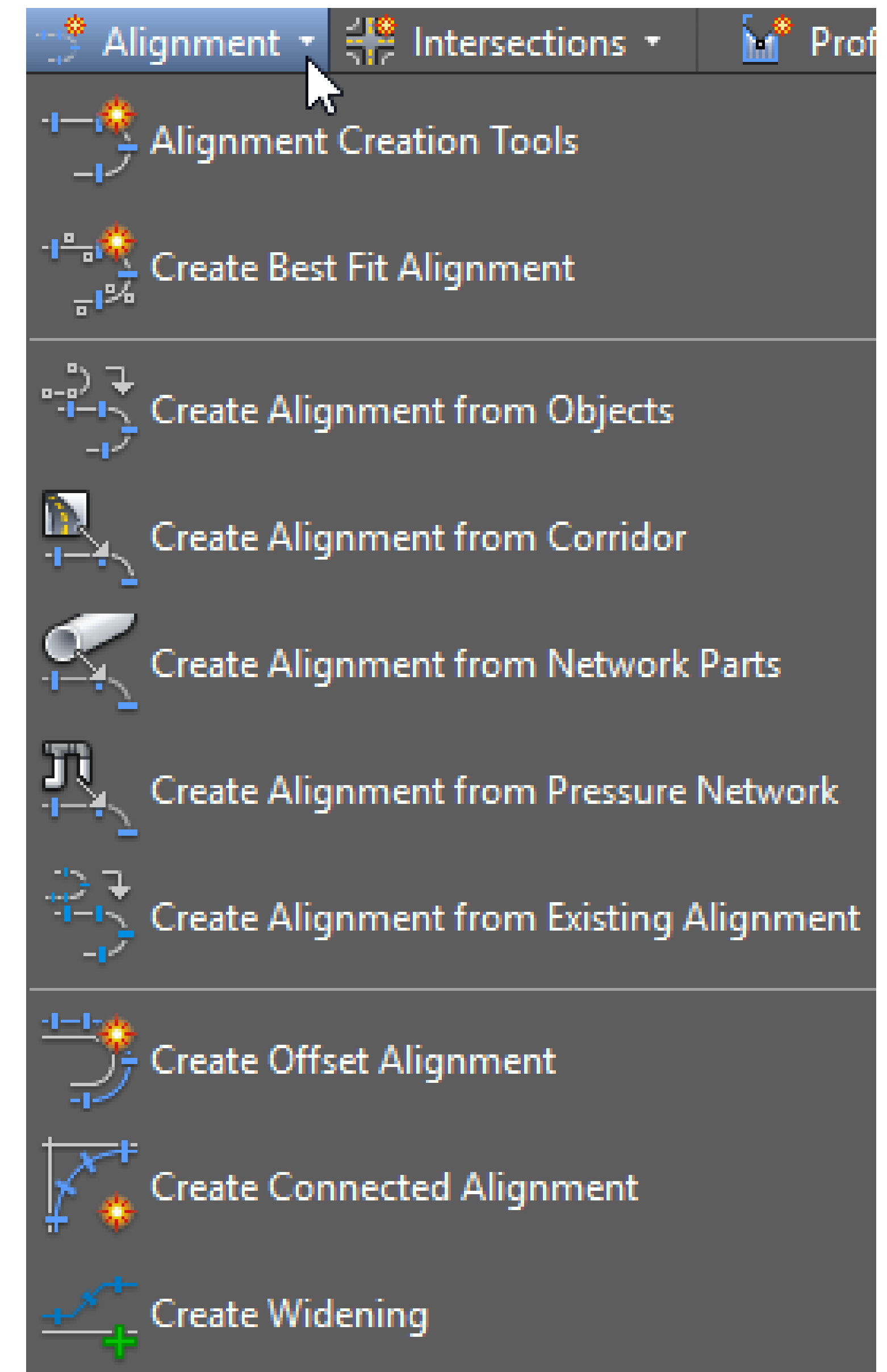
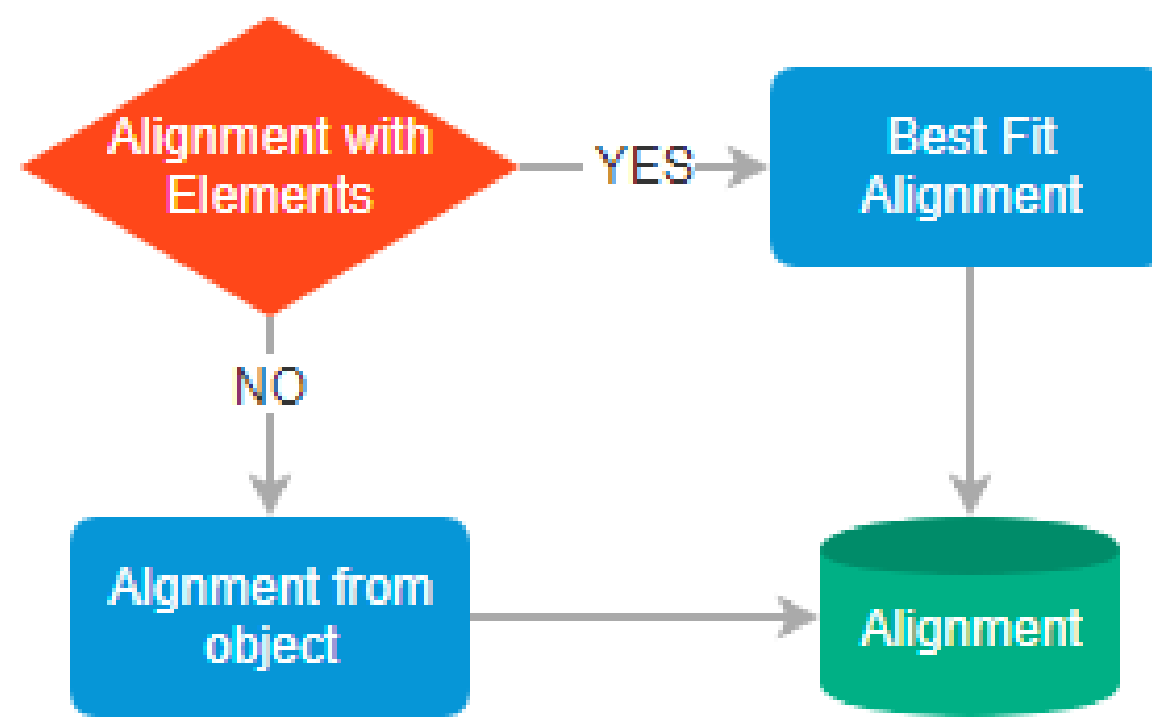


Design

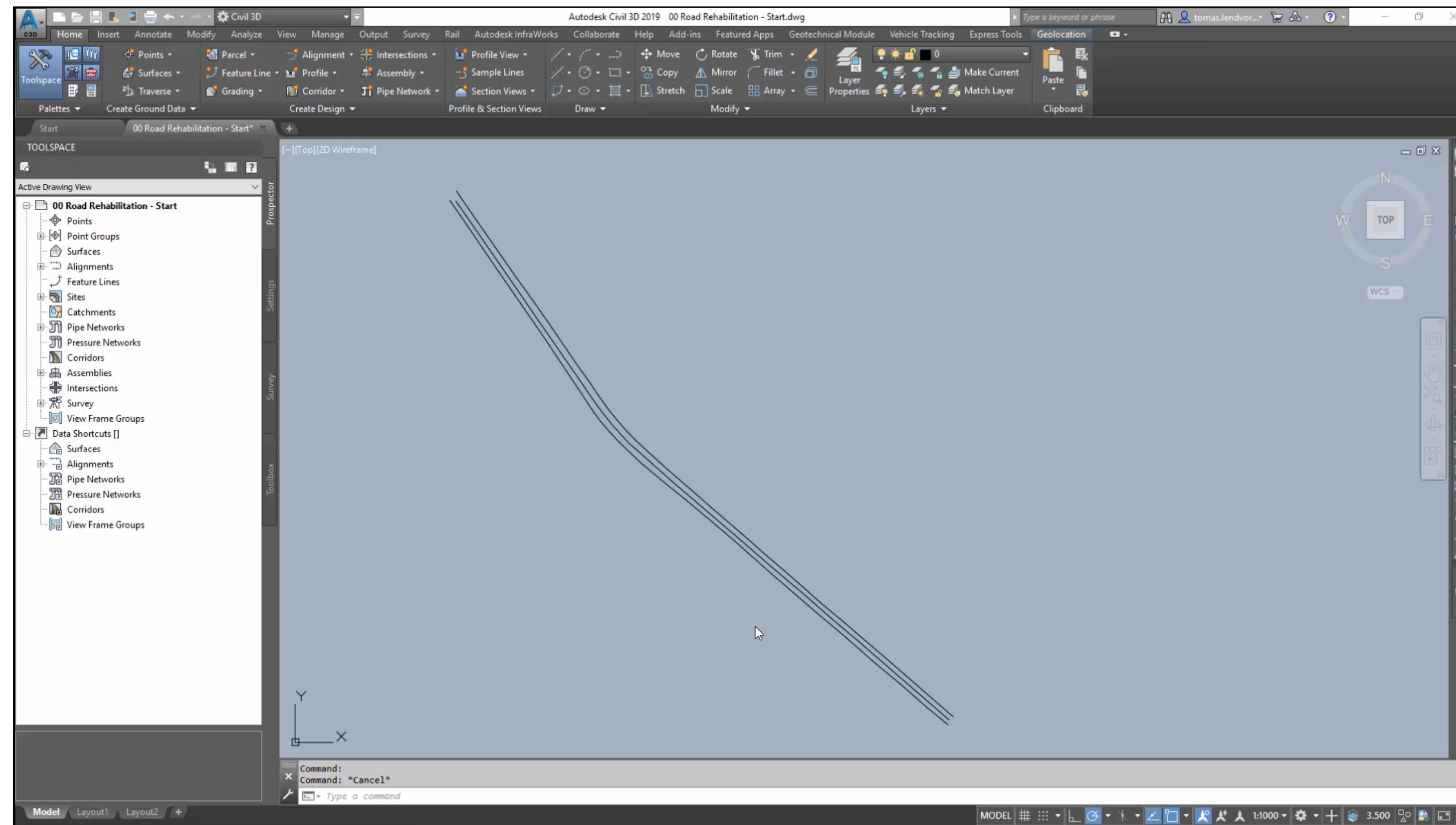


Alignment

- Alignment Creation Tools
 - Fixed/Float Best Fit Line
 - Fixed/Float/Free Best Fit Curve
- Create Best Fit Alignment
- Create Alignment from Object

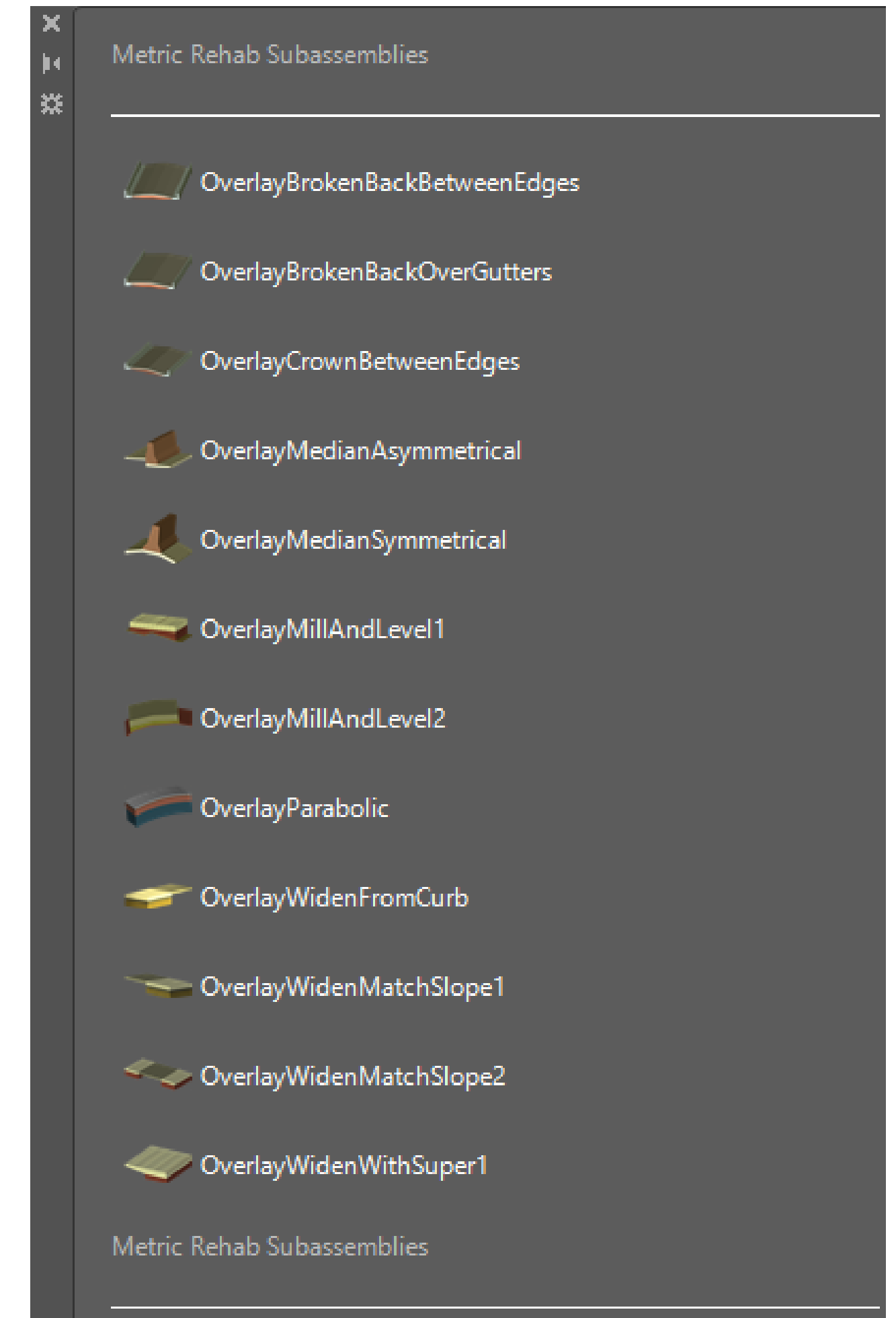
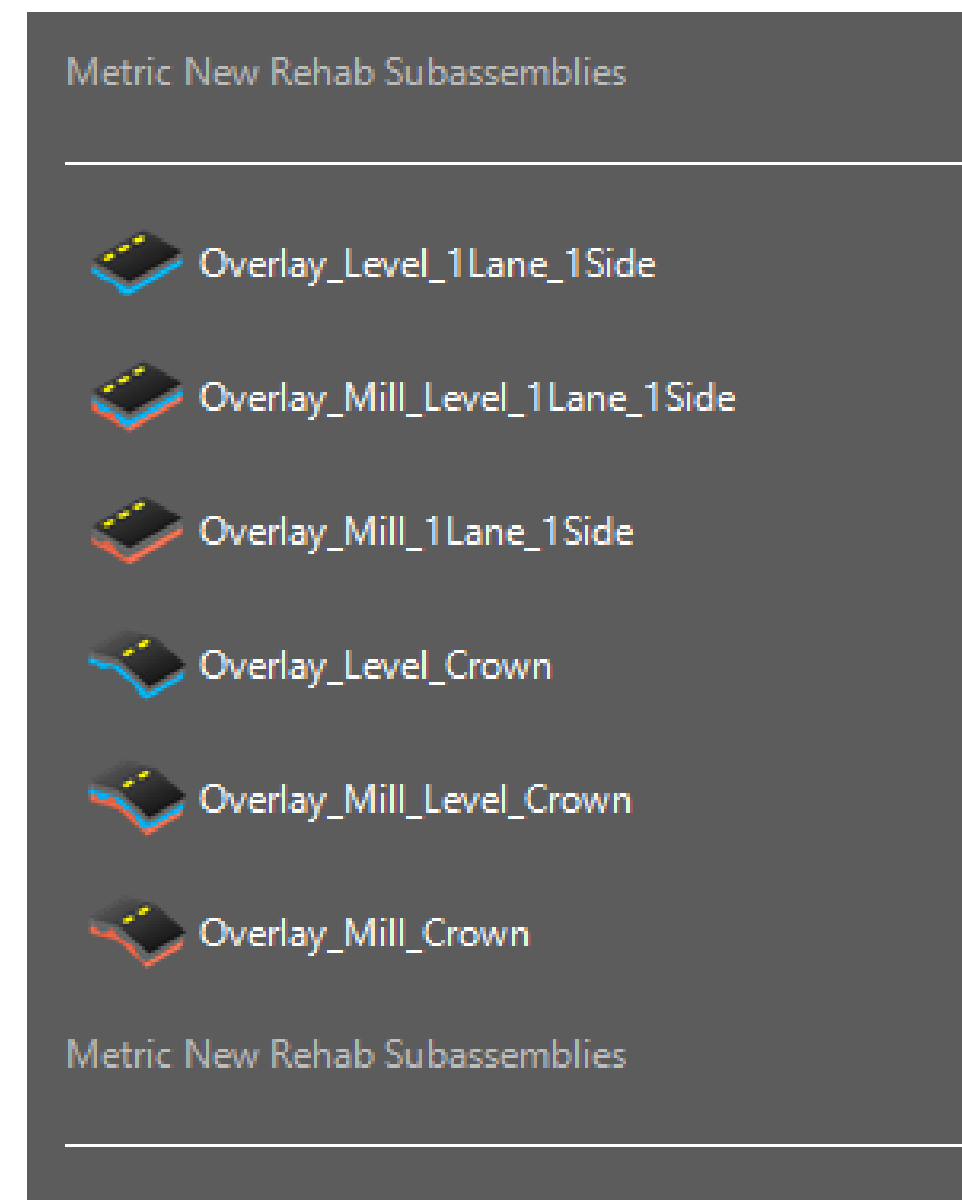


Surface & Alignment



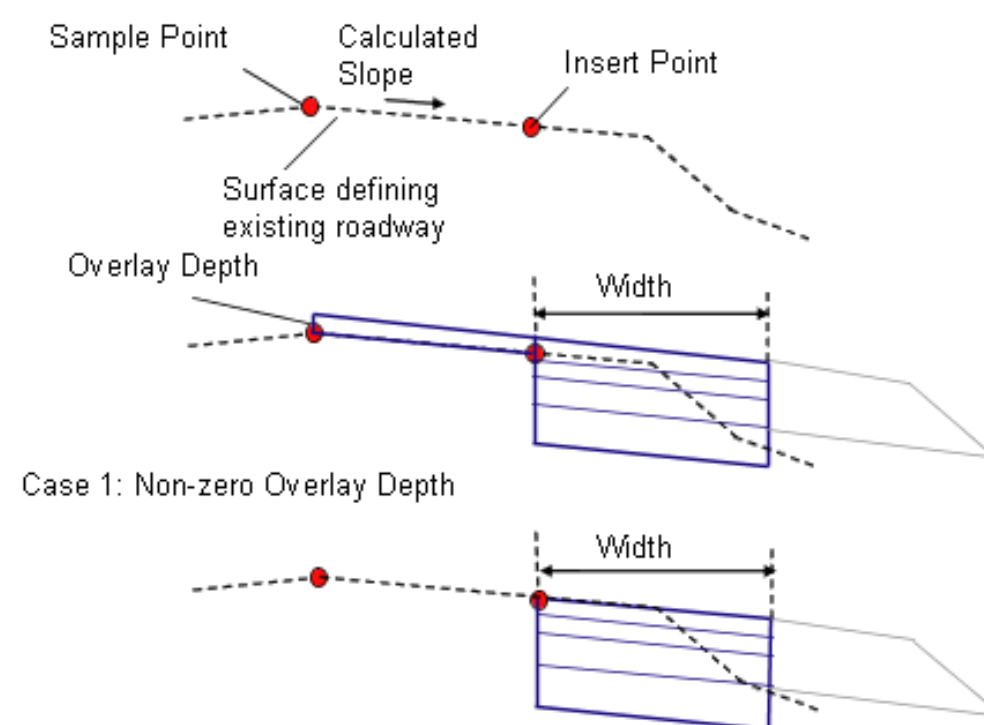
Subassemblies

- Rehab
- **New Rehab**
- Subassembly Composer
- Standard



Rehab Subassemblies

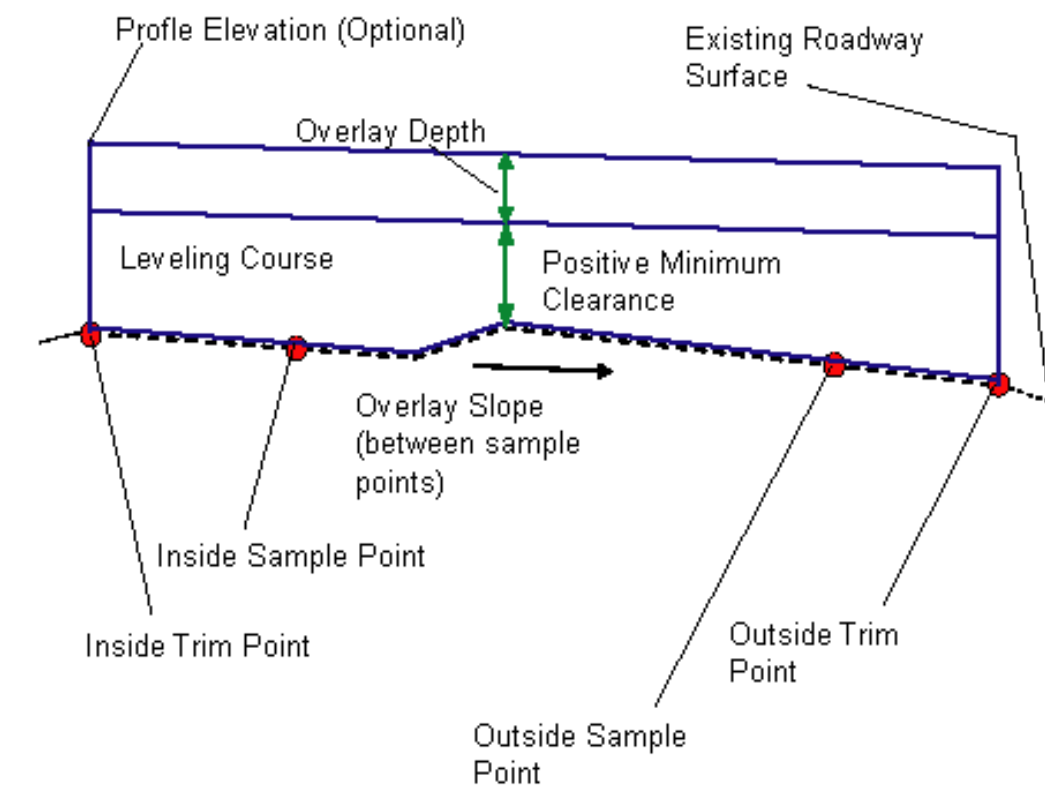
- OverlayMillAndLevel1
- OverlayMillAndLevel2
- OverlayWidenMatchSlope1
- OverlayWidenMatchSlope2
- OverlayWidenWithSuper1



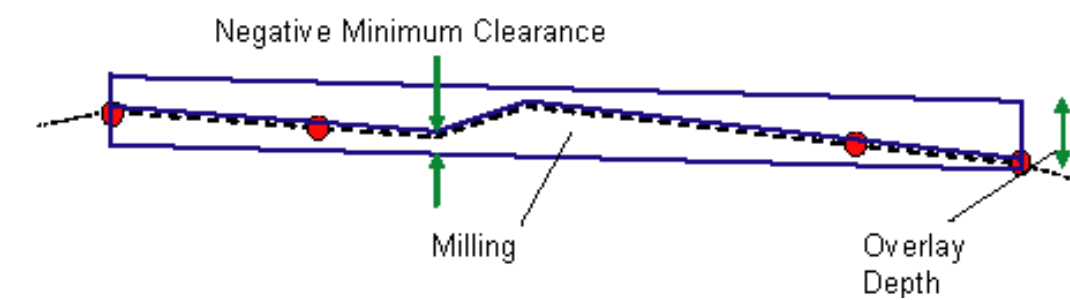
Case 1: Non-zero Overlay Depth

Case 2: Zero Overlay Depth given

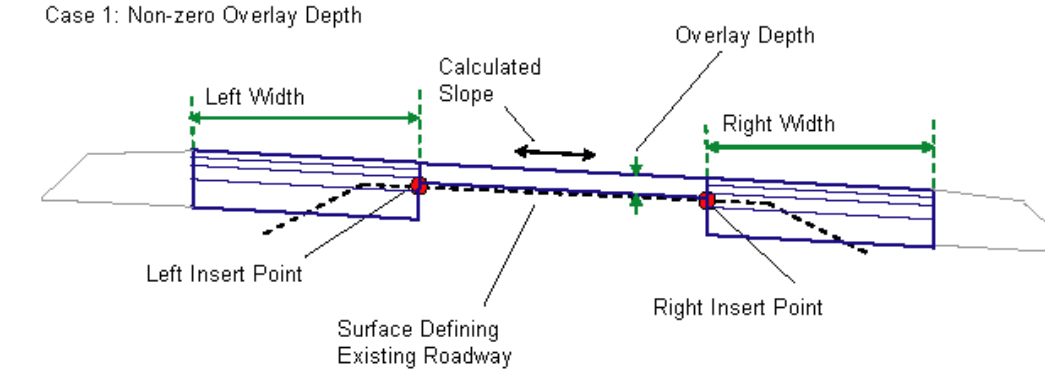
Case 1: Leveling Required



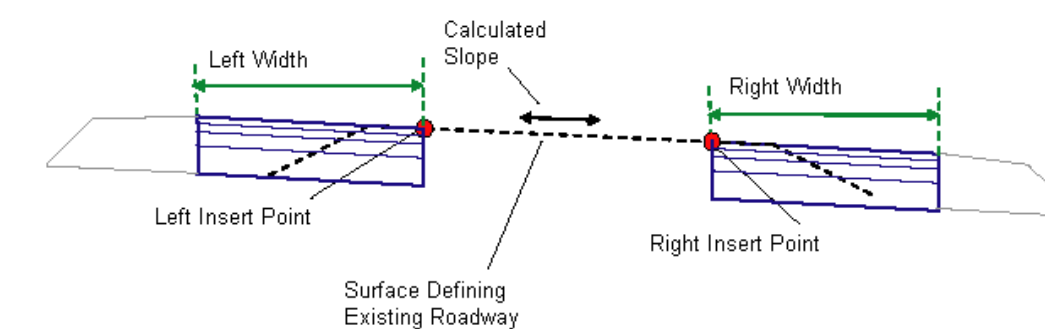
Case 2: Milling Required




Case 1: Non-zero Overlay Depth



Case 2: Zero Overlay Depth Given



MEHC ROAD SUBASSEMBLIES

 OverlayBrokenBackBetweenEdges

 OverlayBrokenBackOverGutters

 OverlayCrownBetweenEdges

 OverlayMedianAsymmetrical

 OverlayMedianSymmetrical

 OverlayMillAndLevel1

 OverlayMillAndLevel2

 OverlayParabolic

 OverlayWidenFromCurb

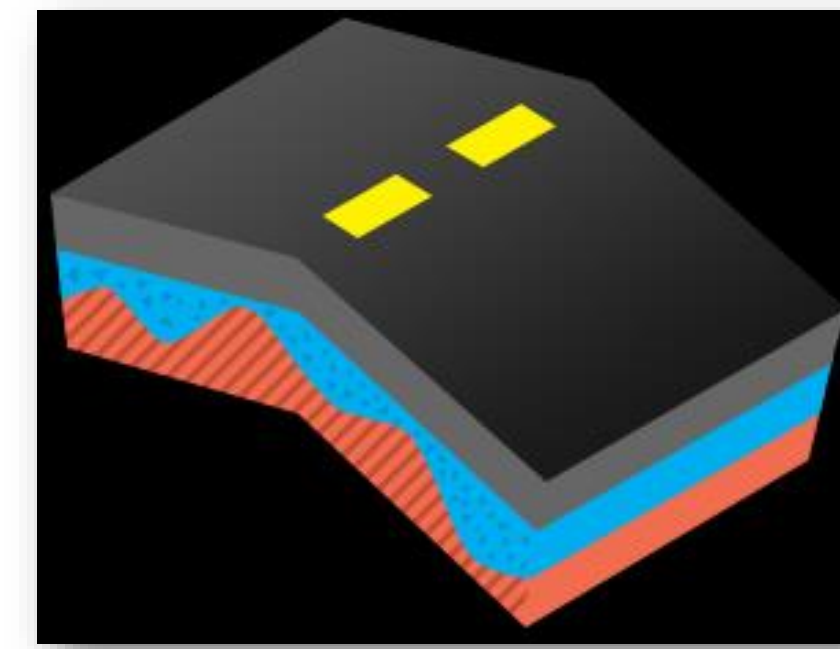
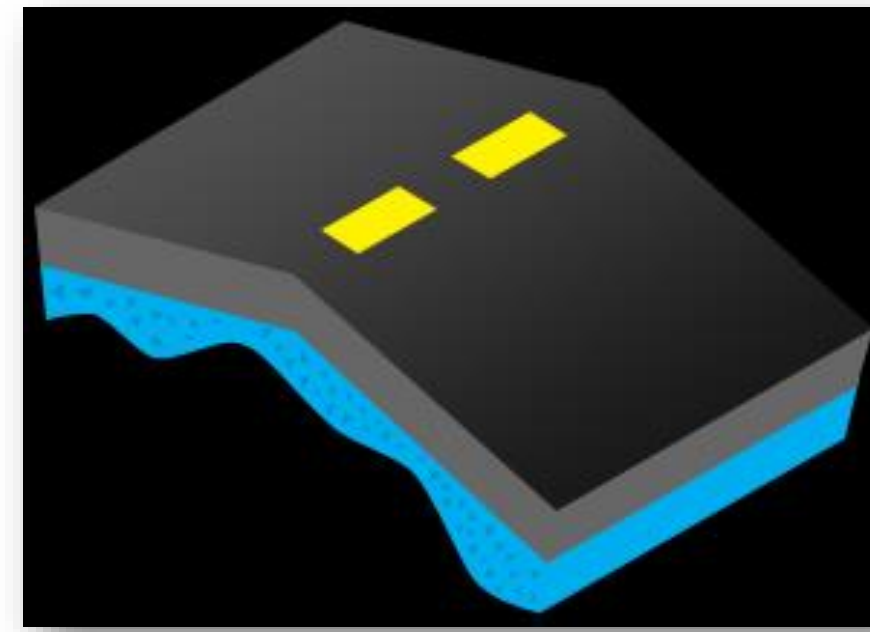
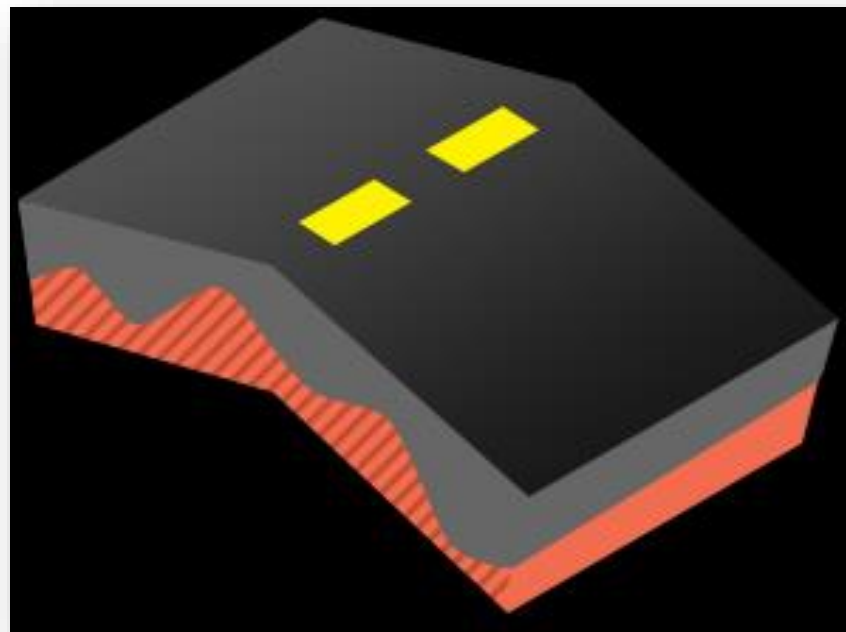
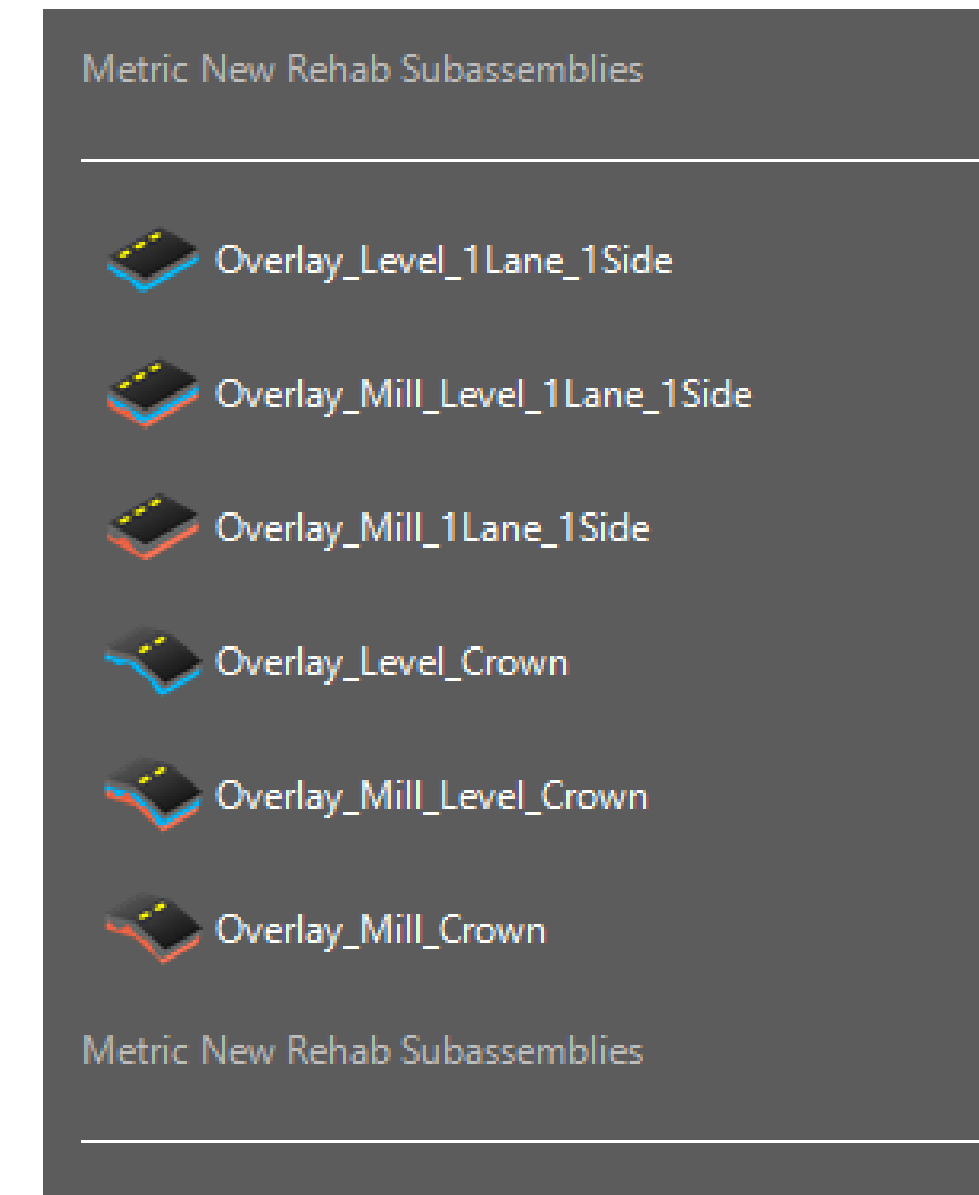
 OverlayWidenMatchSlope1

 OverlayWidenMatchSlope2

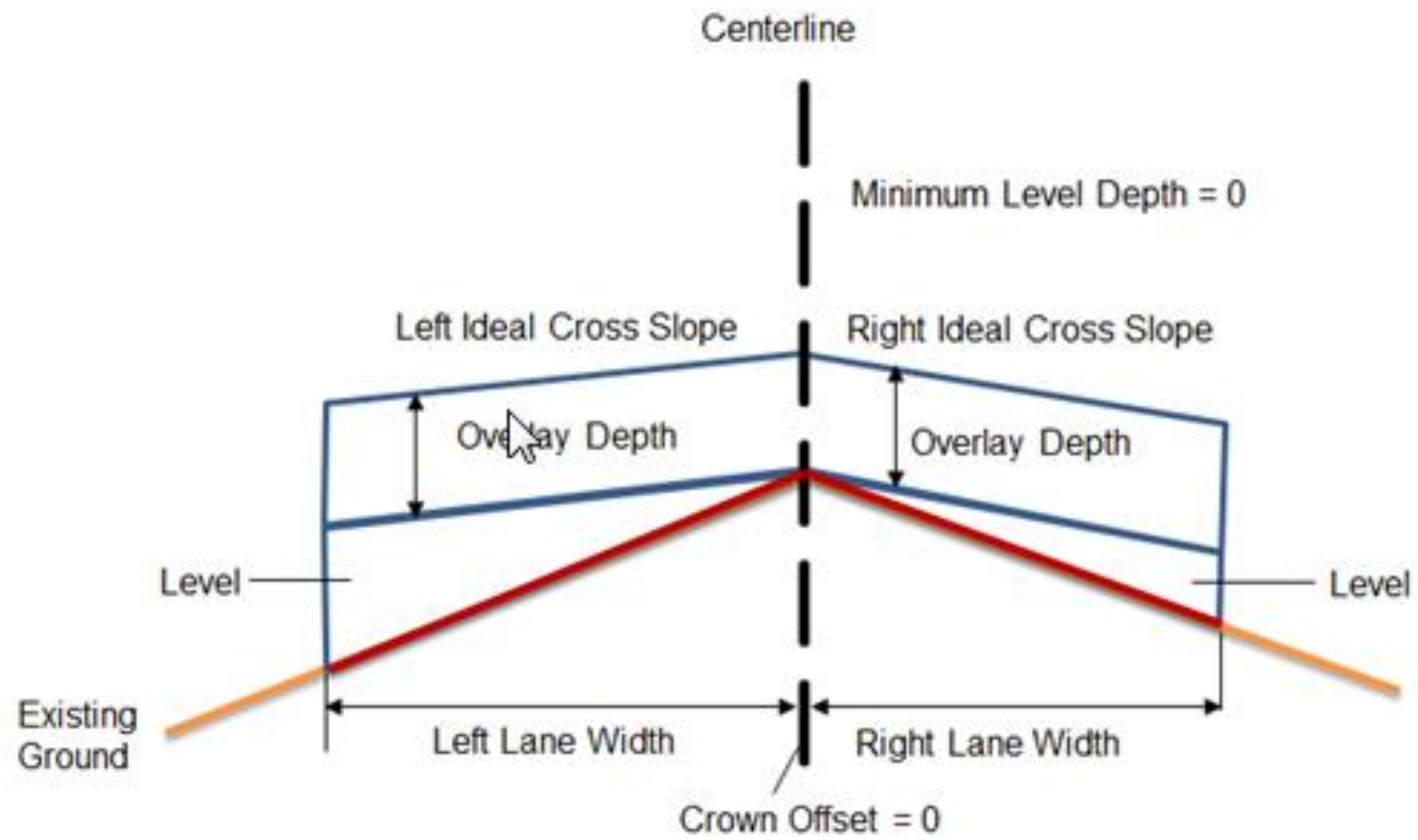
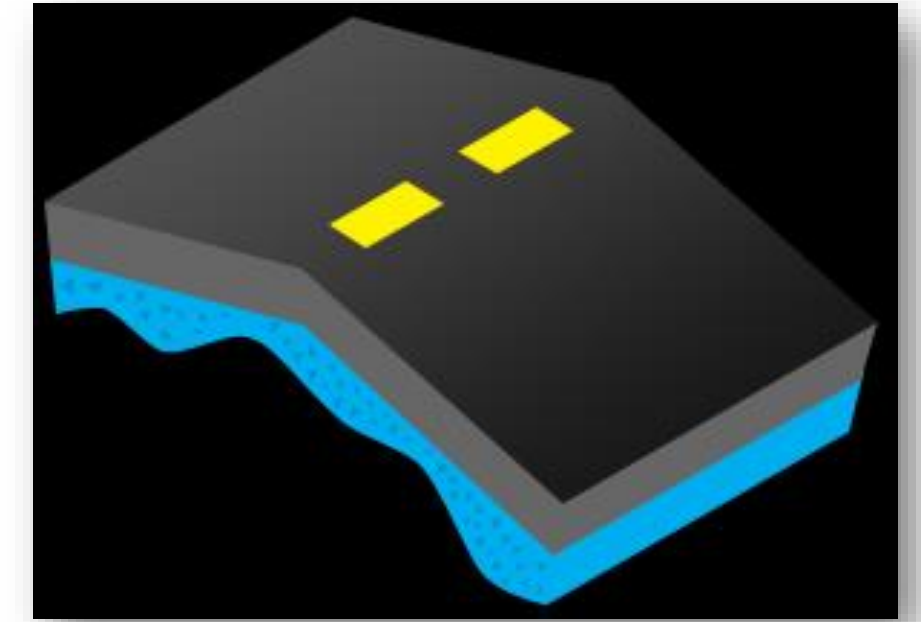
 OverlayWidenWithSuper1

New Rehab Subassemblies

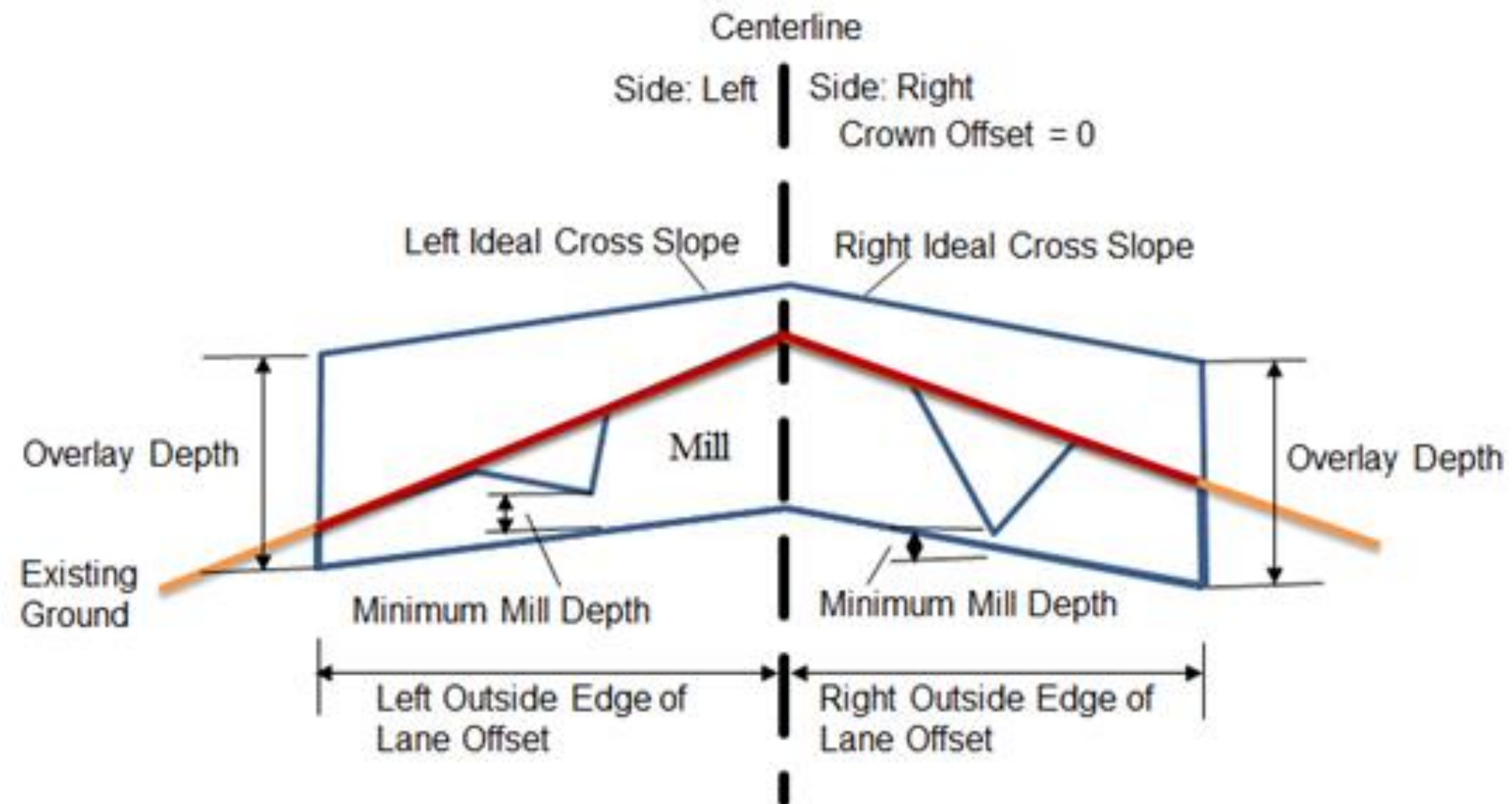
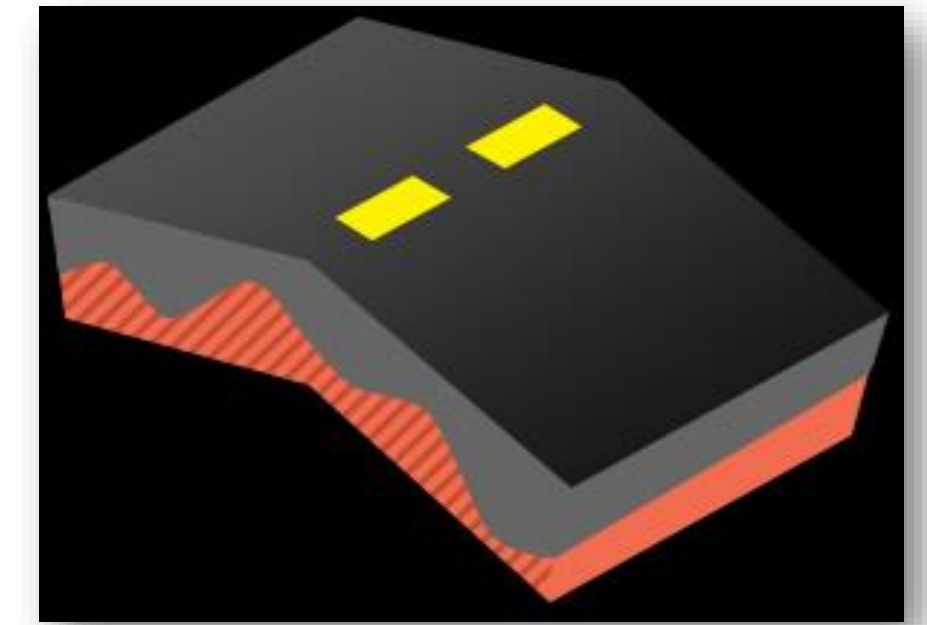
- Overlay and Level
- Overlay and Mill
- Overlay and Mill and Level



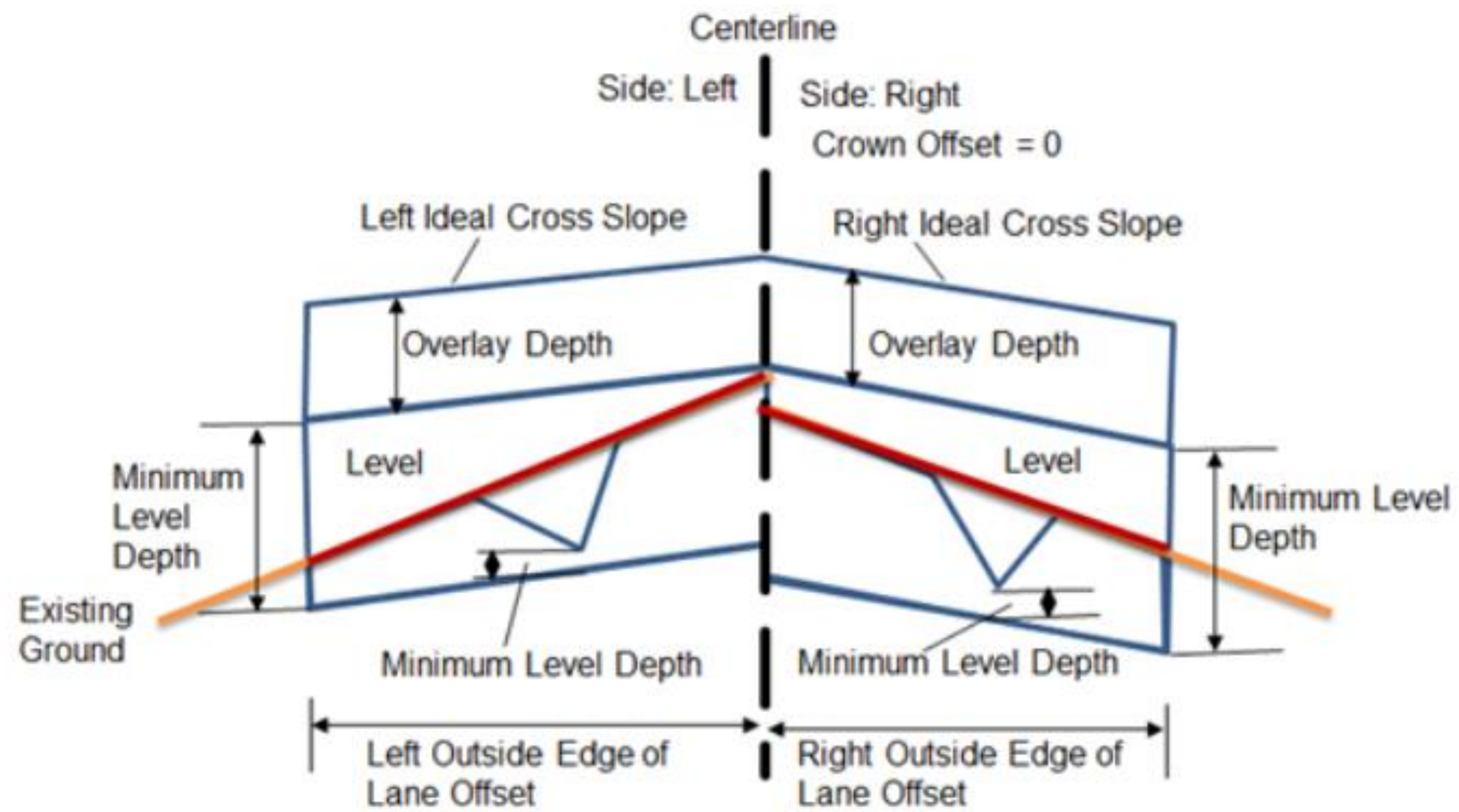
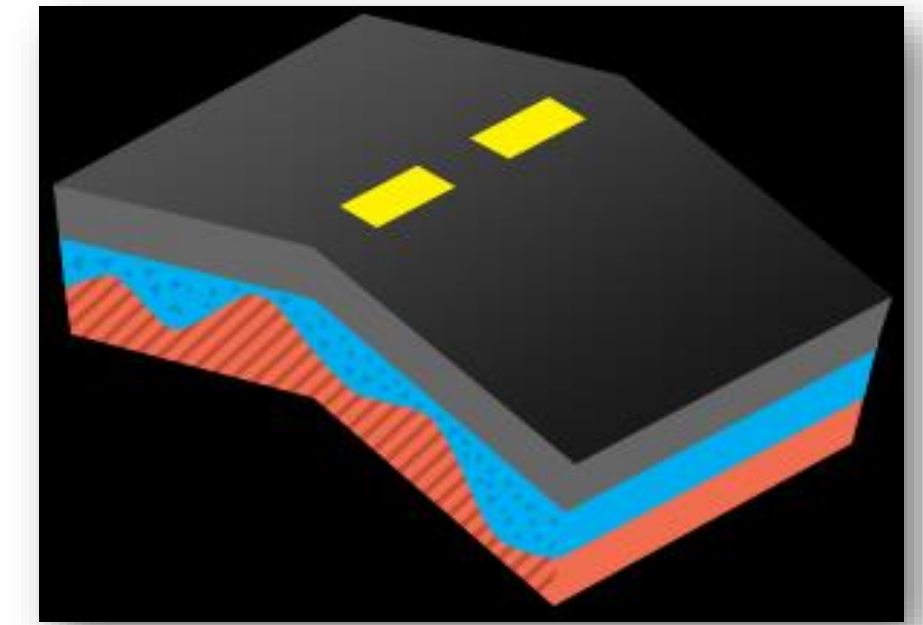
OverlayLevelCrown



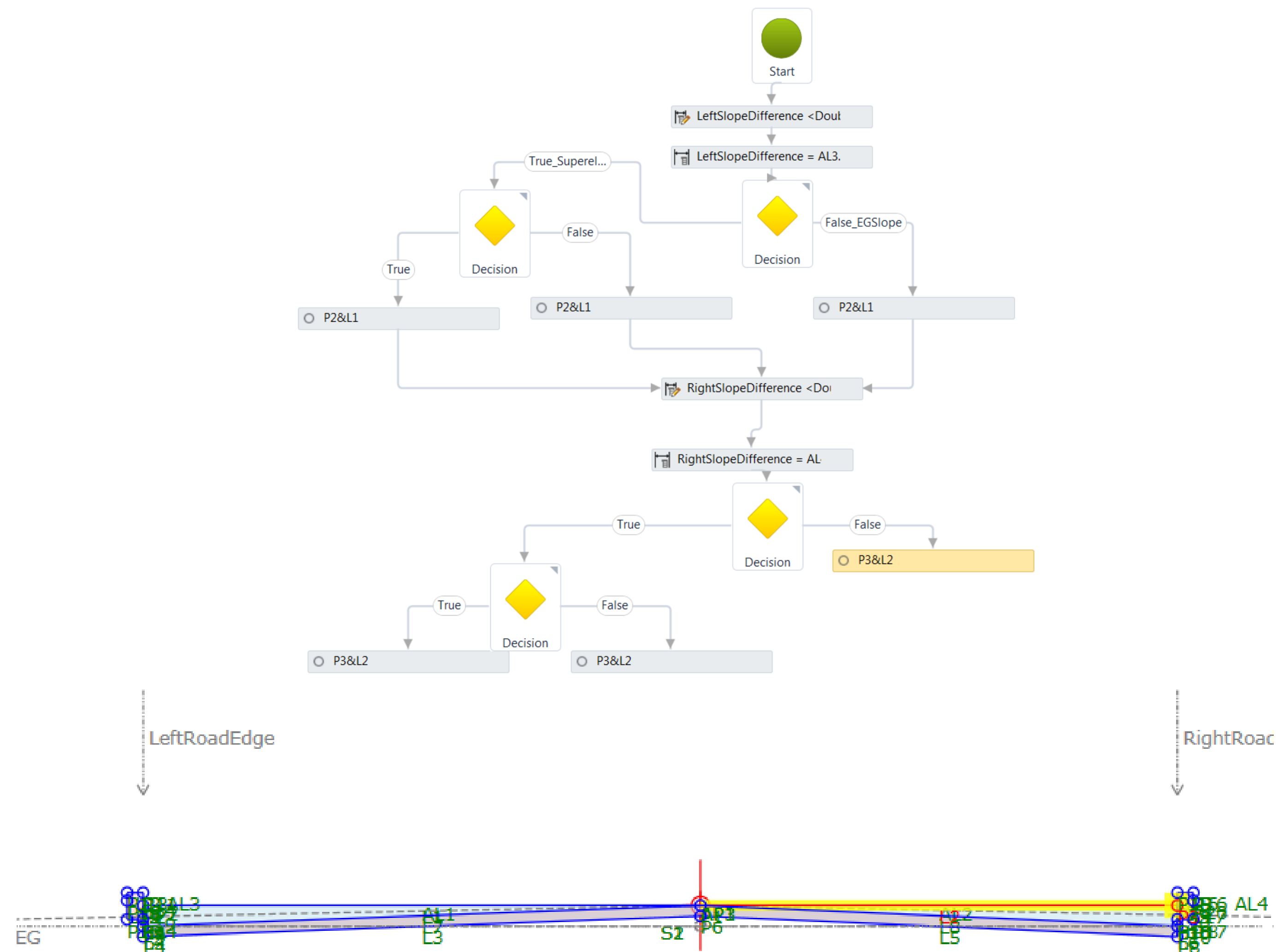
OverlayMillCrown



OverlayMilLevelCrown



Subassembly Composer



The image shows a 'Tool Box' window with a search bar at the top. Below the search bar, there are five main categories, each with a sub-header and a list of tools represented by icons and text labels:

- Geometry**
 - Point (circle icon)
 - Link (two circles connected by a line icon)
 - Shape (rectangle icon)
- Advanced Geometry**
 - Intersection Point (two lines intersecting icon)
 - Curve (curved line icon)
 - Surface Link (line on a surface icon)
 - Daylight Rounding (sun and curve icon)
 - Get Mark Point (point on a line icon)
 - Fillet Arc (arc with dashed lines icon)
 - Offset Geometry (line with offset distance icon)
 - Loop Geometry (circular arrow icon)
- Auxiliary**
 - Auxiliary Point (circle icon)
 - Auxiliary Link (two circles connected by a line icon)
 - Auxiliary Surface Link (line on a surface icon)
 - Auxiliary Intersection (two lines intersecting icon)
 - Auxiliary Mark Point (point on a line icon)
- Workflow**
 - Flowchart (diamond with arrows icon)
 - Sequence (document with arrows icon)
 - Decision (diamond icon)
 - Switch (two arrows icon)
- Miscellaneous**
 - Set Output Parameter (document with arrow icon)
 - Define Variable (document with arrow icon)
 - Set Variable Value (document with arrow icon)
 - Set Mark Point (point on a line icon)
 - Report Message (document with arrow icon)

Standard Subassemblies

Metric Curbs Subassemblies

- UrbanCurbGutterGeneral
- UrbanCurbGutterValley1
- UrbanCurbGutterValley2
- UrbanCurbGutterValley3
- UrbanReplaceCurbGutter1
- UrbanReplaceCurbGutter2
- UrbanReplaceSidewalk
- UrbanSidewalk

Metric Shoulders Subassemblies

- ShoulderExtendAll
- ShoulderExtendSubbase
- ShoulderMultiLayer
- ShoulderMultilayerVaryingWidth
- ShoulderMultiSurface
- ShoulderVerticalSubbase
- ShoulderWidening
- ShoulderWithSubbaseInterlaced
- ShoulderWithSubbaseInterlacedAndDitch

Metric Shoulders Subassemblies

Metric Generic Subassemblies

- LinkMulti
- LinkOffsetAndElevation
- LinkOffsetAndSlope
- LinkOffsetOnSurface
- LinkSlopeAndVerticalDeflection
- LinkSlopesBetweenPoints
- LinkSlopeToElevation
- LinkSlopeToSurface
- LinkToMarkedPoint
- LinkToMarkedPoint2
- LinkVertical
- LinkWidthAndSlope
- LotGrade
- MarkPoint

Metric Generic Subassemblies

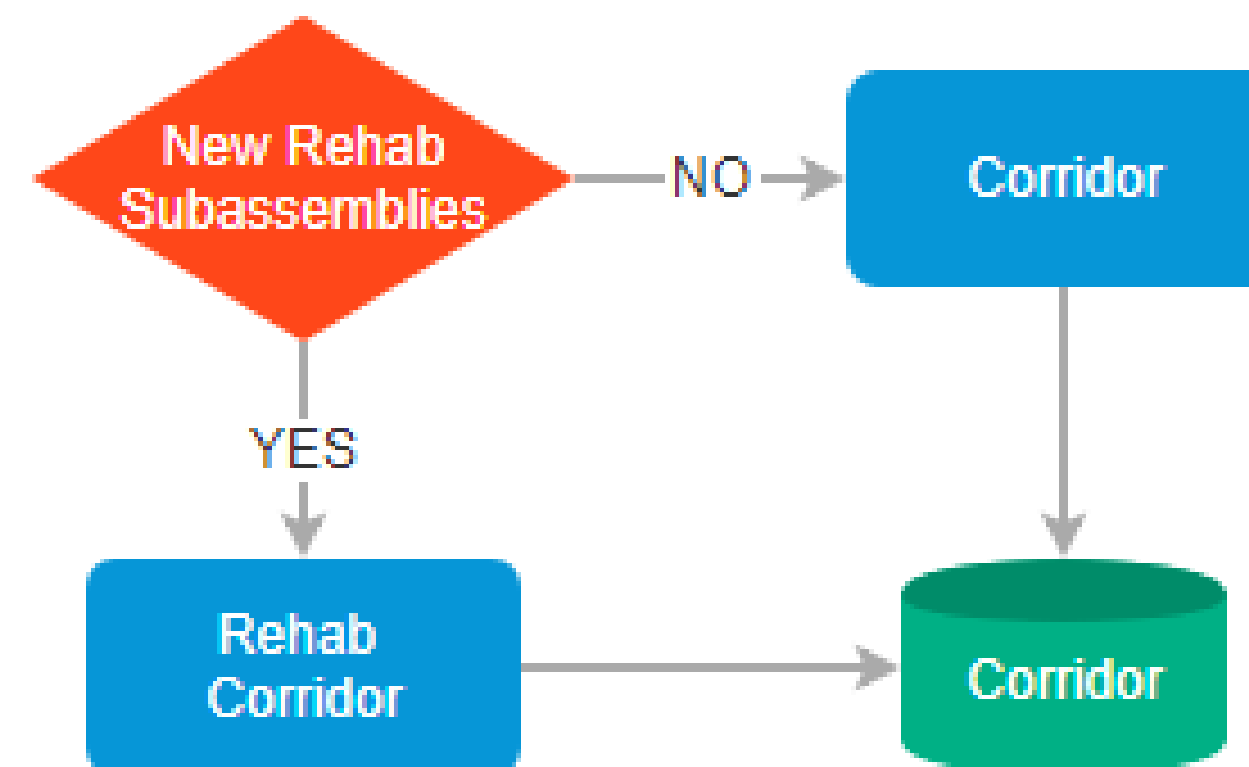
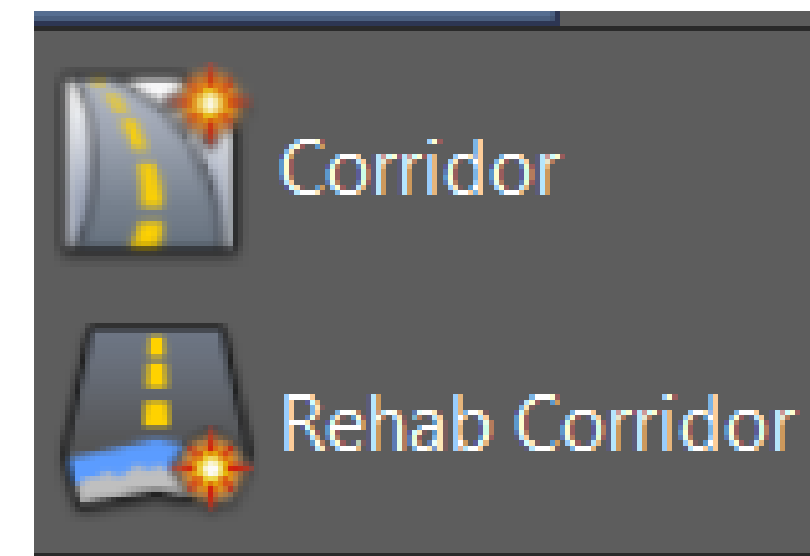
Metric Daylight Subassemblies

- DaylightBasin
- DaylightBasin2
- DaylightBench
- DaylightGeneral
- DaylightInsideROW
- DaylightMaxOffset
- DaylightMaxWidth
- DaylightMinOffset
- DaylightMinWidth
- DaylightMultiIntercept
- DaylightMultipleSurface
- DaylightRockCut
- DaylightStandard
- DaylightToOffset
- DaylightToROW
- StrippingPavement
- StrippingTopSoil

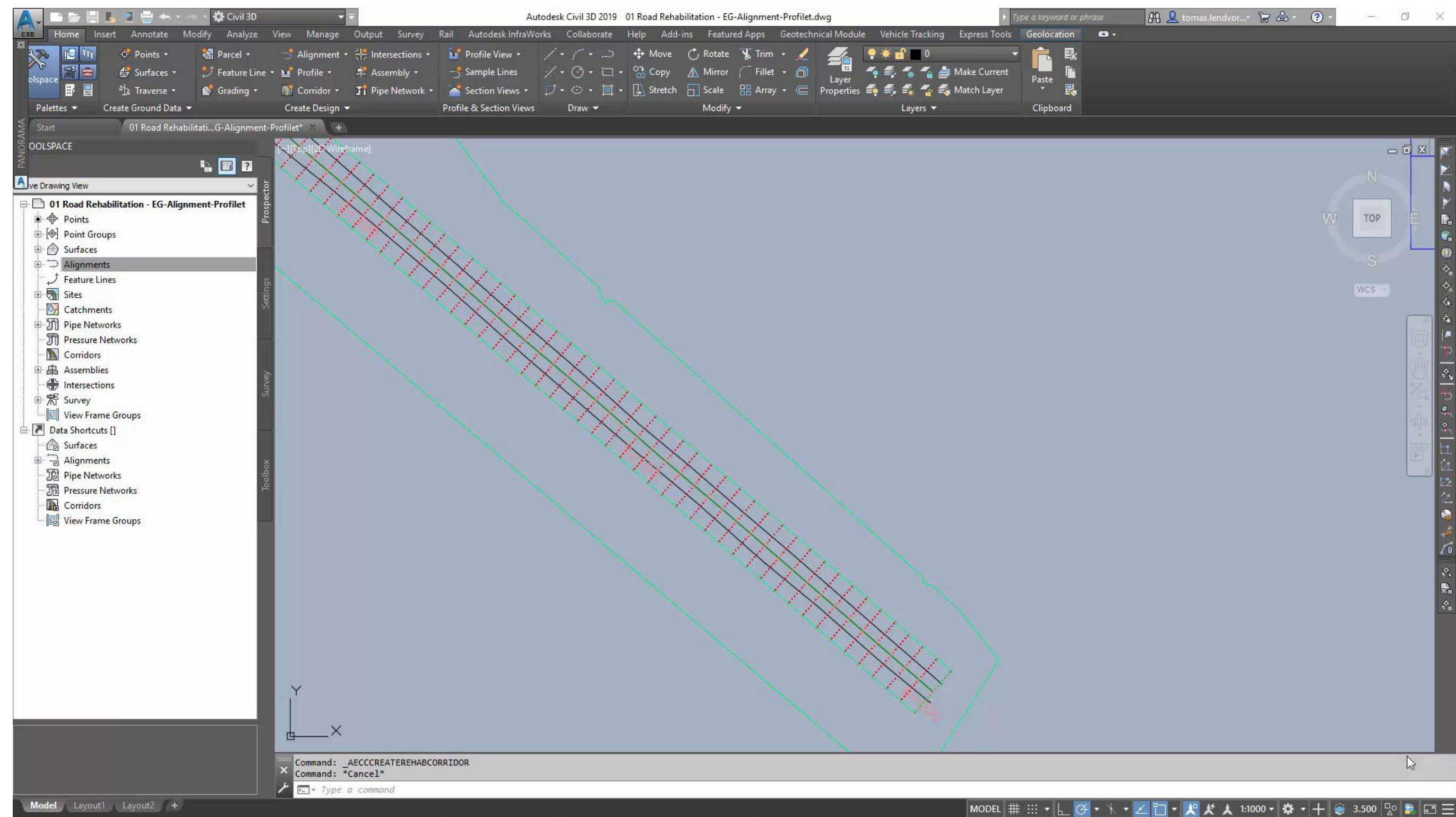
Metric Daylight Subassemblies

Corridor

- Corridor
 - Standard
 - Rehab



Corridor & Reports

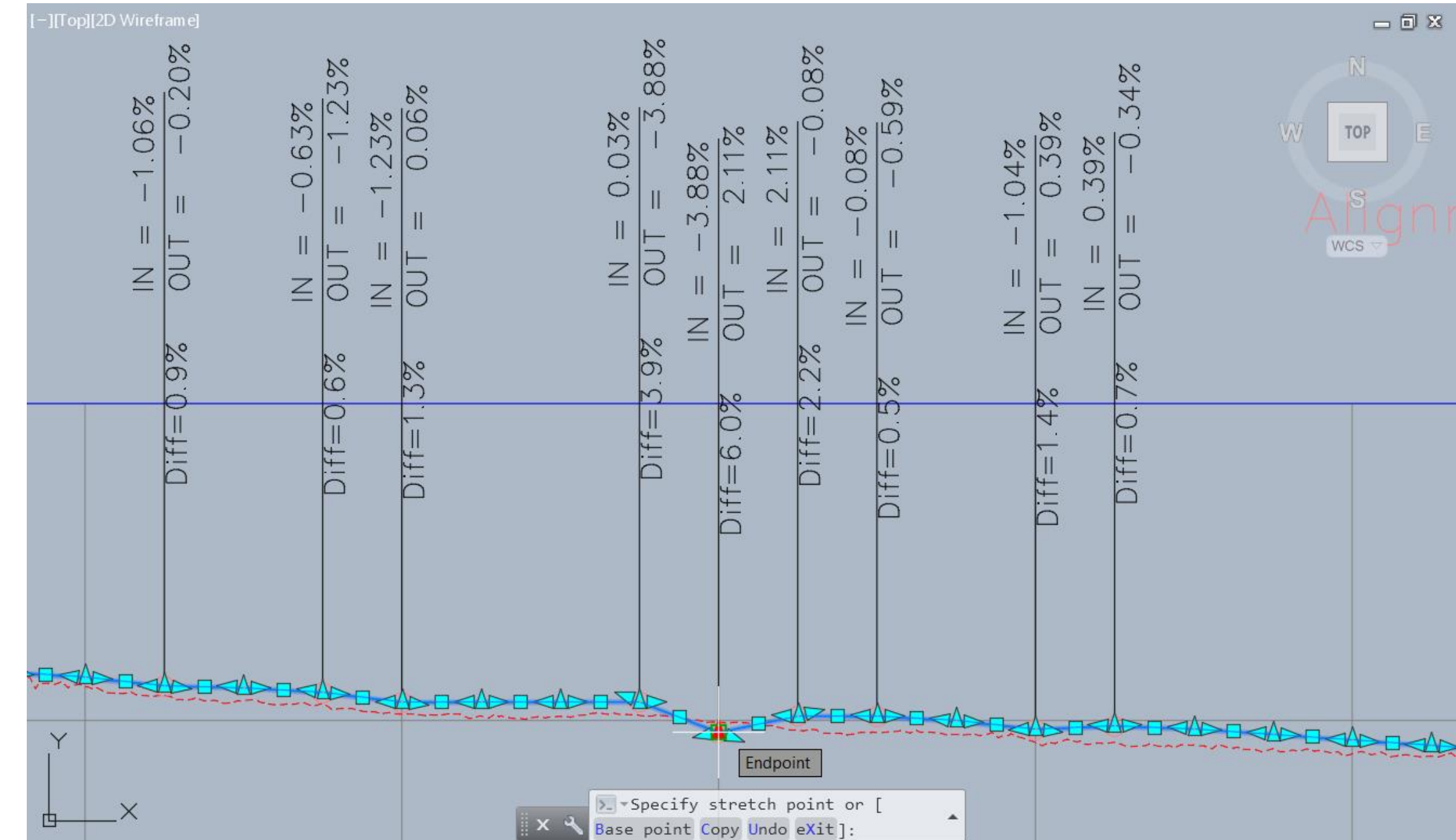


Road Crown

- Derived from Rehab Subassembly, EG and parameters
- Might be “bumpy“, eg. IN/OUT grade exceeds defined value
- Smoothing might be required

Expressions:

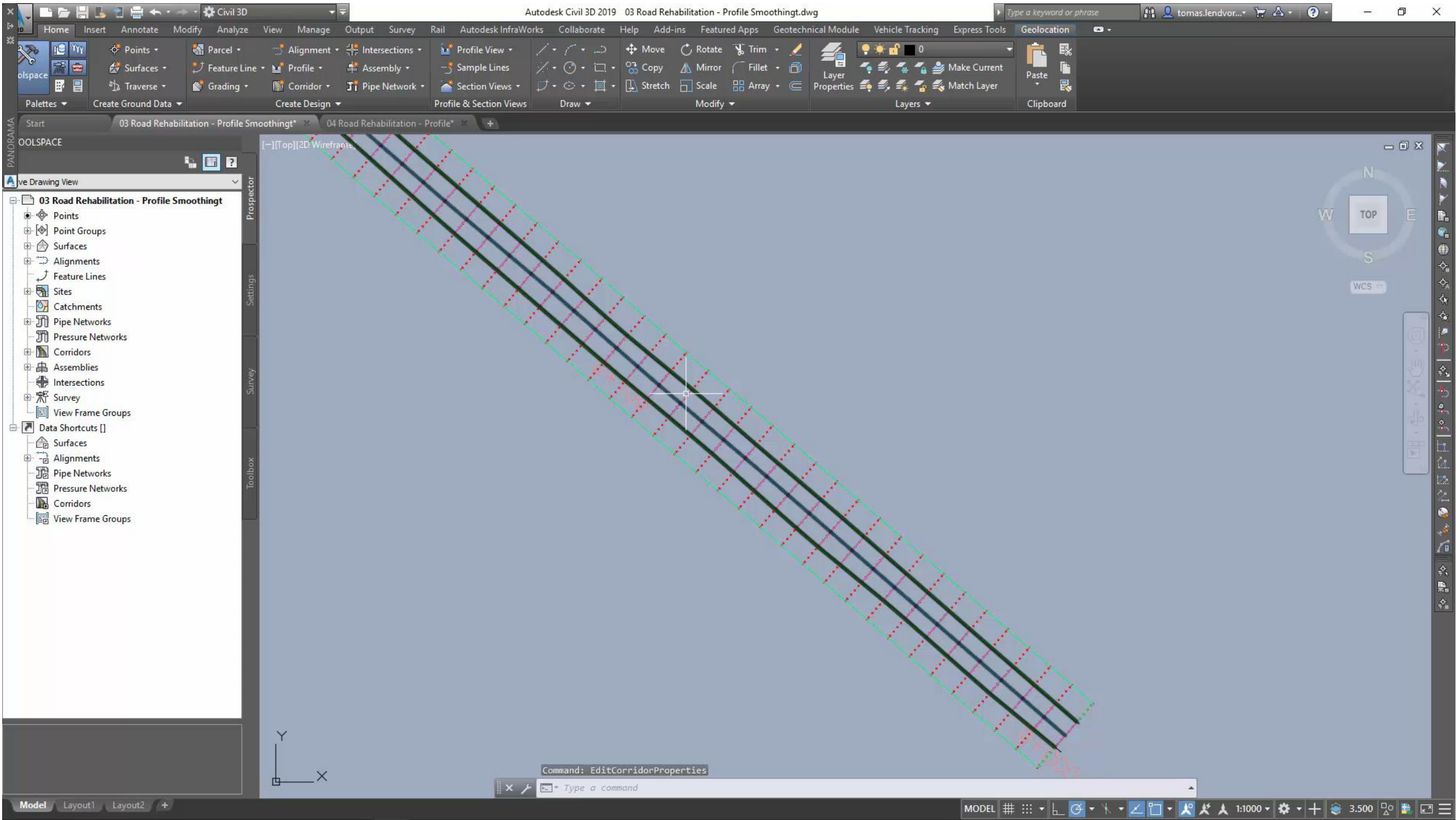
- GradeDifference
 - $(\text{ABS}(\{\text{Grade Out}\} - \{\text{Grade In}\})) * 100$
- TextHeight
 - $\text{IF}(((\text{GradeDifference})) < 0.5, 0, 0.0025)$
- LineLength
 - $\text{IF}((\text{GradeDifference}) < 0.5, 0, 0.075)$



Component name: GradeDifference

Property	Value
General	
Name	GradeDifference
Visibility	True
Anchor Component	PVIE
Anchor Point	Top Left
Text	
Contents	{\Fsimplex.shx c...
Text Height	TextHeight
Rotation Angle	0.0000 (d)
Attachment	Middle center
X Offset	-15.00mm
Y Offset	-1.50mm
Color	BYLAYER
Lineweight	ByLayer
Maximum Width	0.00mm

Profile Smoothing



Analysis



Reports

- Standard

CHAINAGE 0+025.000

POINT	X	Y	Z	OFFSET	STRING CUT
1	6,540,483.7059	5,601,407.0893	234.2550	-3.335m	P2
2	6,540,483.7774	5,601,407.1709	234.3093	-3.226m	KN
3	6,540,483.7774	5,601,407.1709	234.2093	-3.226m	KN_Nałożenie
4	6,540,485.9031	5,601,409.5978	234.0573	0.000m	Korona
5	6,540,485.9031	5,601,409.5978	233.9573	0.000m	Korona_Nałożenie
6	6,540,487.9409	5,601,411.9245	233.7668	3.093m	KN_Nałożenie
7	6,540,487.9409	5,601,411.9245	233.8668	3.093m	KN
8	6,540,488.0348	5,601,412.0317	233.7955	3.235m	P2

- Rehab Corridor Reports

Koridor - (1) > BL - Alignment - Rehab - (2) > <div>RG - Vzorový</div> Start station: 50.00mEnd station: 150.00m															
Cross Slope Correction Report		Milling and Leveling Report													
Offset:		5.00m													
Station	Edge Point 2		Edge Point 1		Control Point 1		Incremental Offset Report			Control Point 1		Edge Point 1		Edge Point 2	
	Offset	Mill/Level Denth	Offset	Mill/Level Denth	Offset	Mill/Level Denth	-5.00m	0.00m	5.00m	Offset	Mill/Level Denth	Offset	Mill/Level Denth	Offset	Mill/Level Denth
50.00m	-3.61m	-0.34m	1.00m	-0.47m	1.00m	-0.47m		-0.48m		3.82m	-0.30m	1.00m	-0.47m	3.82m	-0.30m
53.10m	-3.52m	-0.34m	1.00m	-0.46m	1.00m	-0.46m		-0.47m		3.84m	-0.30m	1.00m	-0.46m	3.84m	-0.30m
58.31m	-3.35m	-0.33m	1.00m	-0.44m	1.00m	-0.44m		-0.46m		1.98m	-0.30m	1.00m	-0.44m	3.85m	-0.33m
59.42m	-3.42m	-0.33m	1.00m	-0.46m	1.00m	-0.46m		-0.48m		1.58m	-0.30m	1.00m	-0.46m	3.86m	-0.32m
63.76m	-3.68m	-0.30m	1.00m	-0.50m		-0.30m		-0.50m		1.00m	-0.50m	1.00m	-0.50m	3.87m	-0.32m
63.80m	-3.68m	-0.30m	1.00m	-0.50m	-3.68m	-0.30m		-0.50m		1.00m	-0.50m	1.00m	-0.50m	3.87m	-0.32m
64.45m	-3.72m	-0.30m	1.00m	-0.51m	-3.72m	-0.30m		-0.51m		1.00m	-0.51m	1.00m	-0.51m	3.87m	-0.32m
73.02m	-3.60m	-0.31m	1.00m	-0.50m	-3.60m	-0.31m		-0.51m		2.89m	-0.30m	1.00m	-0.50m	3.89m	-0.30m
75.00m	-3.57m	-0.31m	1.00m	-0.50m	-3.57m	-0.31m		-0.51m		3.51m	-0.30m	1.00m	-0.50m	3.89m	-0.30m
76.18m	-3.55m	-0.30m	1.00m	-0.50m	-3.55m	-0.30m		-0.51m		3.87m	-0.30m	1.00m	-0.50m	3.89m	-0.30m
76.24m	-3.55m	-0.30m	1.00m	-0.50m	-3.55m	-0.30m		-0.51m		3.89m	-0.30m	1.00m	-0.50m	3.89m	-0.30m
76.61m	-3.54m	-0.30m	1.00m	-0.50m	-3.54m	-0.30m		-0.51m		3.86m	-0.30m	1.00m	-0.50m	3.89m	-0.30m
78.60m	-3.55m	-0.31m	1.00m	-0.50m	-3.55m	-0.31m		-0.51m		3.68m	-0.30m	1.00m	-0.50m	3.90m	-0.30m
100.00m	-3.58m	-0.33m	1.00m	-0.49m	1.00m	-0.49m		-0.50m		1.79m	-0.30m	1.00m	-0.49m	3.91m	-0.30m
117.37m	-3.61m	-0.32m	1.00m	-0.47m	1.00m	-0.47m		-0.47m		1.00m	-0.47m	1.00m	-0.47m	3.93m	-0.30m
118.86m	-3.61m	-0.32m	1.00m	-0.47m	1.00m	-0.47m		-0.47m		1.00m	-0.47m	1.00m	-0.47m	3.93m	-0.30m
119.52m	-3.62m	-0.32m	1.00m	-0.47m	1.00m	-0.47m		-0.47m		1.38m	-0.30m	1.00m	-0.47m	3.93m	-0.30m
120.93m	-3.62m	-0.32m	1.00m	-0.48m	1.00m	-0.48m		-0.47m		1.00m	-0.48m	1.00m	-0.48m	3.93m	-0.30m
125.00m	-3.64m	-0.32m	1.00m	-0.46m	1.00m	-0.46m		-0.46m		1.00m	-0.46m	1.00m	-0.46m	3.83m	-0.31m
126.03m	-3.65m	-0.32m	1.00m	-0.46m	1.00m	-0.46m		-0.45m		1.00m	-0.46m	1.00m	-0.46m	3.81m	-0.31m
128.64m	-3.66m	-0.32m	1.00m	-0.46m	1.00m	-0.46m		-0.45m		1.00m	-0.46m	1.00m	-0.46m	3.82m	-0.31m
129.47m	-3.67m	-0.32m	1.00m	-0.46m	1.00m	-0.46m		-0.45m		1.00m	-0.46m	1.00m	-0.46m	3.83m	-0.31m
142.71m	-3.74m	-0.32m	1.00m	-0.45m	1.00m	-0.45m		-0.44m		1.00m	-0.45m	1.00m	-0.45m	3.92m	-0.31m
142.76m	-3.74m	-0.32m	1.00m	-0.46m	1.00m	-0.46m		-0.44m		1.00m	-0.46m	1.00m	-0.46m	3.92m	-0.31m
143.68m	-3.74m	-0.30m	1.00m	-0.55m	-3.74m	-0.30m		-0.52m		1.00m	-0.55m	1.00m	-0.55m	3.93m	-0.34m
150.00m	-3.75m	-0.34m	1.00m	-0.68m	-1.39m	-0.46m		-0.63m		1.00m	-0.68m	1.00m	-0.68m	3.96m	-0.38m

Analysis

- Section views and annotation
- Volumetric calculation
- Corridor surfaces
- TIN Volume surface
- Surface Analysis
- Surface labels

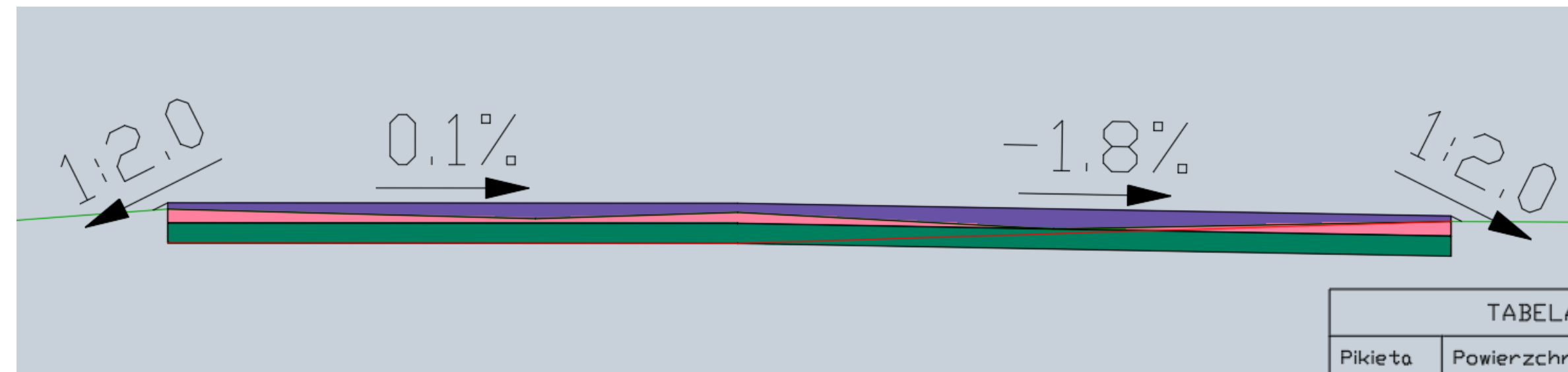
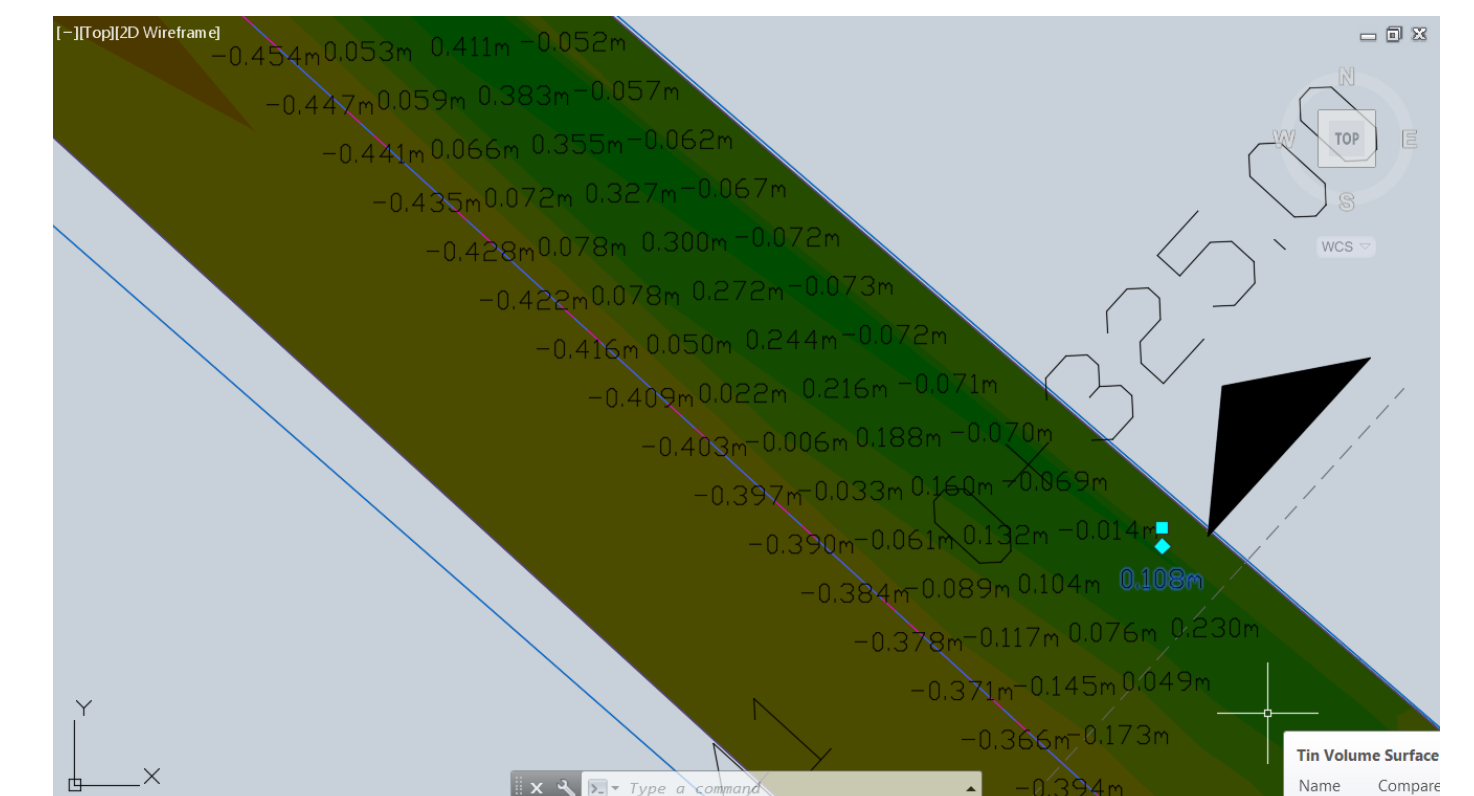
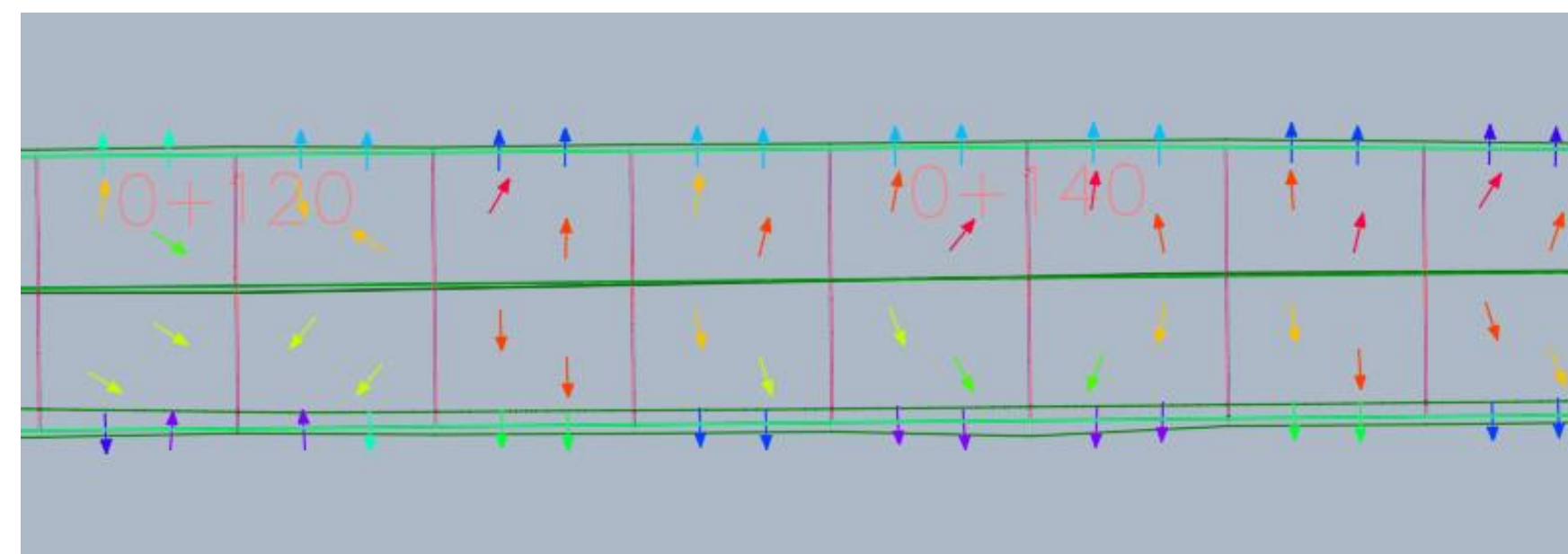
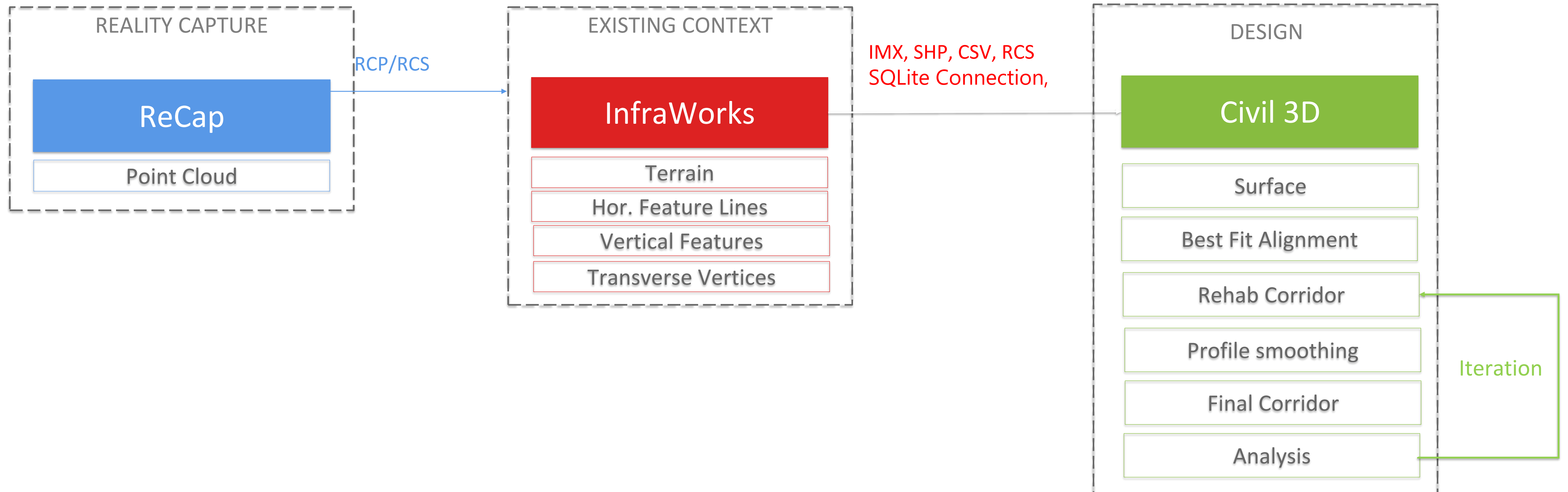


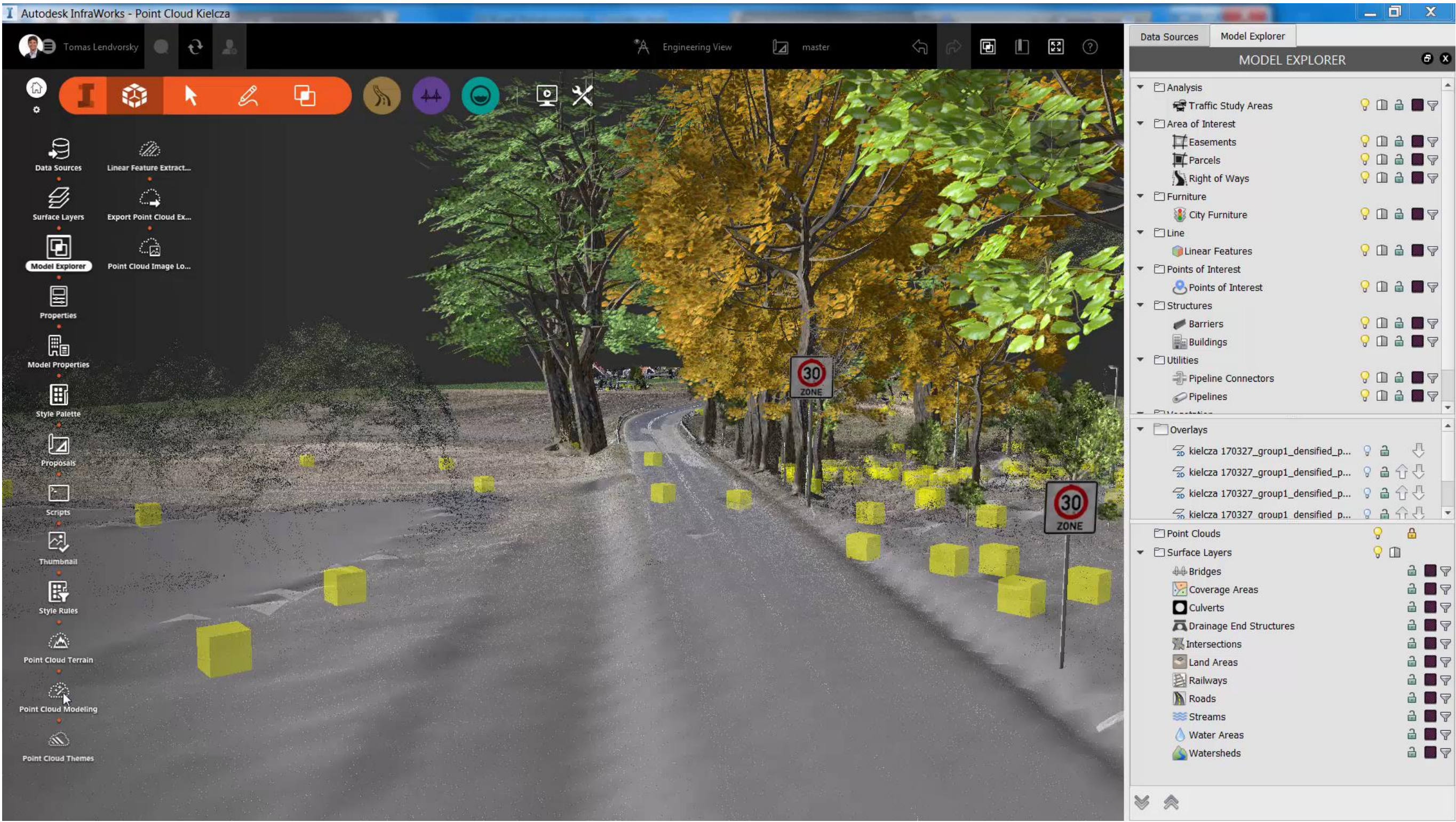
TABELA MATERIAŁU FREZ			
Pikieta	Powierzchnia	Objętość	Objętość całkowita
0+025.00	0.75	0.00	0.00
0+050.00	0.90	20.58	20.58
0+075.00	0.72	20.29	40.87
0+100.00	0.75	18.42	59.29
0+125.00	0.76	18.86	78.16
0+150.00	0.68	18.00	96.15
0+175.00	0.80	18.45	114.60
0+200.00	0.77	19.55	134.15
0+225.00	0.67	17.93	152.09
0+250.00	0.70	17.08	169.17
0+275.00	0.88	19.76	188.93
0+300.00	0.83	21.44	210.37
0+325.00	2.37	40.08	250.45



Road Rehabilitation Workflow



Vertical Features



Traffic Simulation

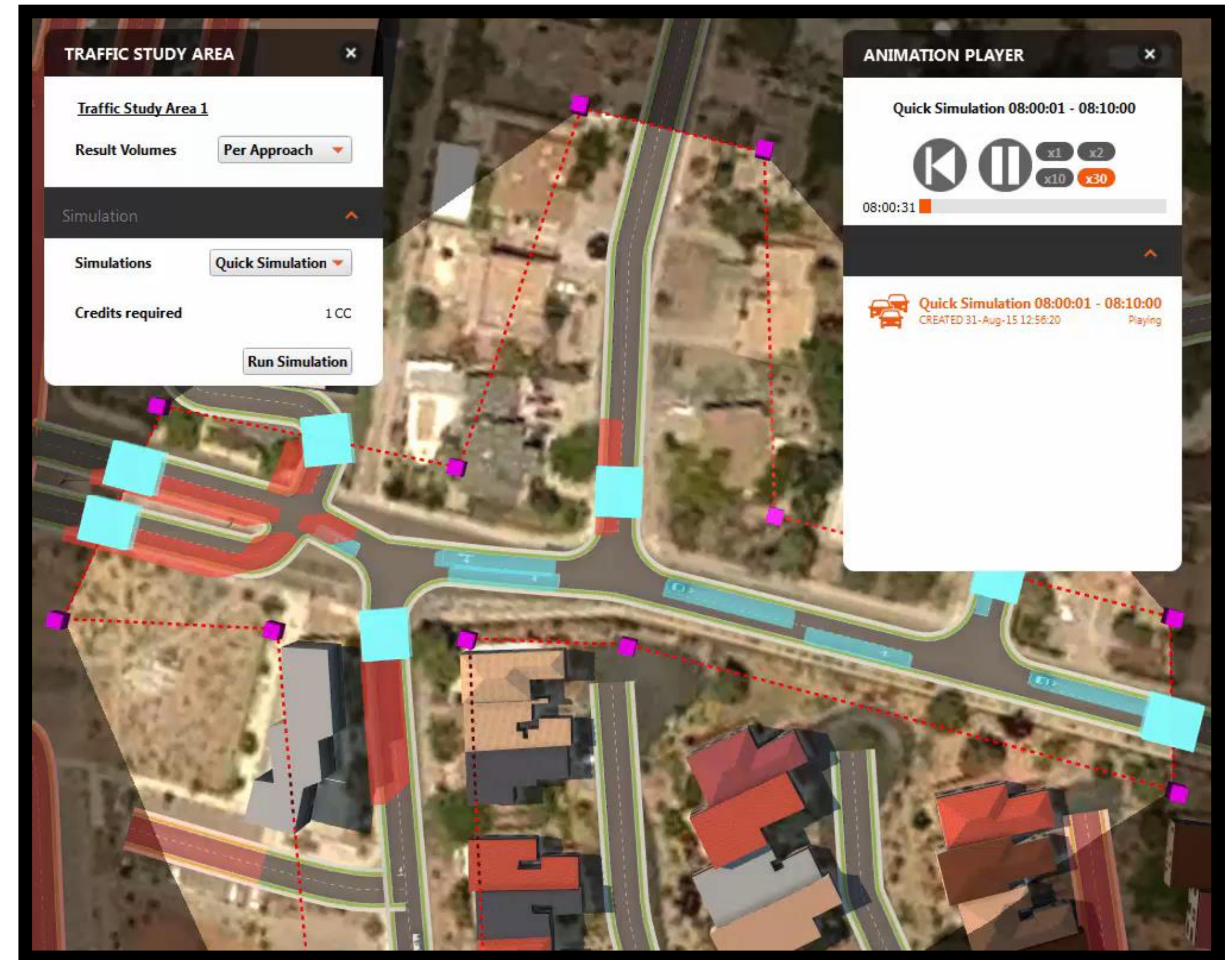


Traffic Simulation – Why?



Make Decissions based on Traffic analytics

- Analyze traffic flow for complex road systems
- Identify problem areas, redesign, and re-analyze
- Easy, visual approach yet robust and sophisticated
- Visual results are easy to understand and explain



Definition:

Demand Division

Demand Divisions

People

Private Vehicles

Freight

Division	101 Small Car	102 Medium Car	103 Large Car	104 SUV	105 Van	106 Truck
Division	35.0	10.0	30.0	10.0	5.0	10.0

Help

Apply

OK

Reset

Cancel

Definition: Demand Editor

Demand Editor

Demand: **AM60**

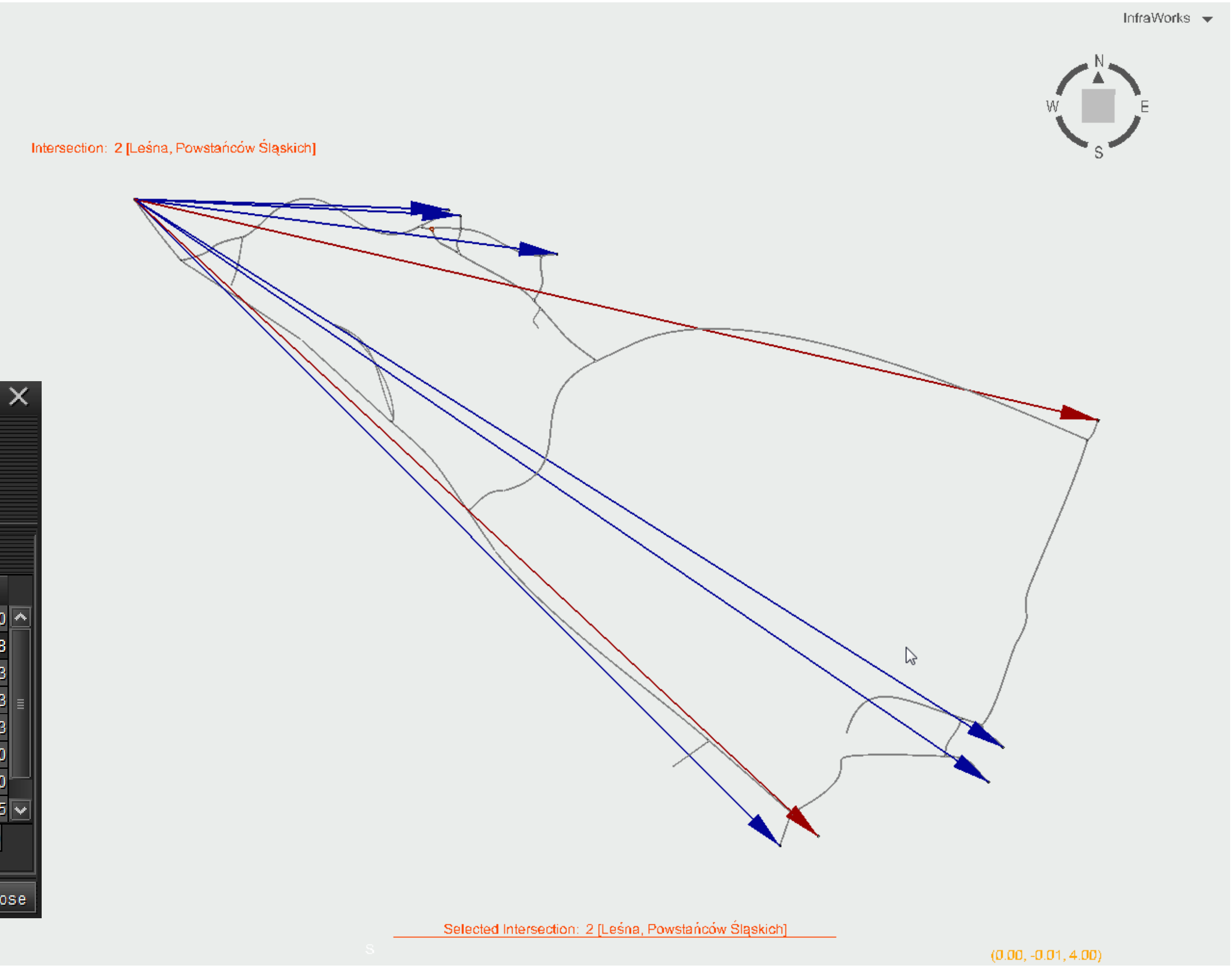
Directed Demand: Origin-Destination Matrices **Undirected Demand: Origin Volumes**

Kielcza

Profile: **Simulation** Division: **Division**

	Profile	1	2	3	4	5	Total
1			8	8	8	8	60
2		150		8	8	500	838
3		8	8		8	8	103
4		8	60	8		8	113
5		8	8	8	8		553
6		8	8	8	8	8	60
7		8	55	8	8	500	600
8		8	8	8	8	50	245
Total		203	160	60	60	1010	2630

Help **OK** **Close**





Definition: Demand Editor

Demand Editor




Demand: AM60

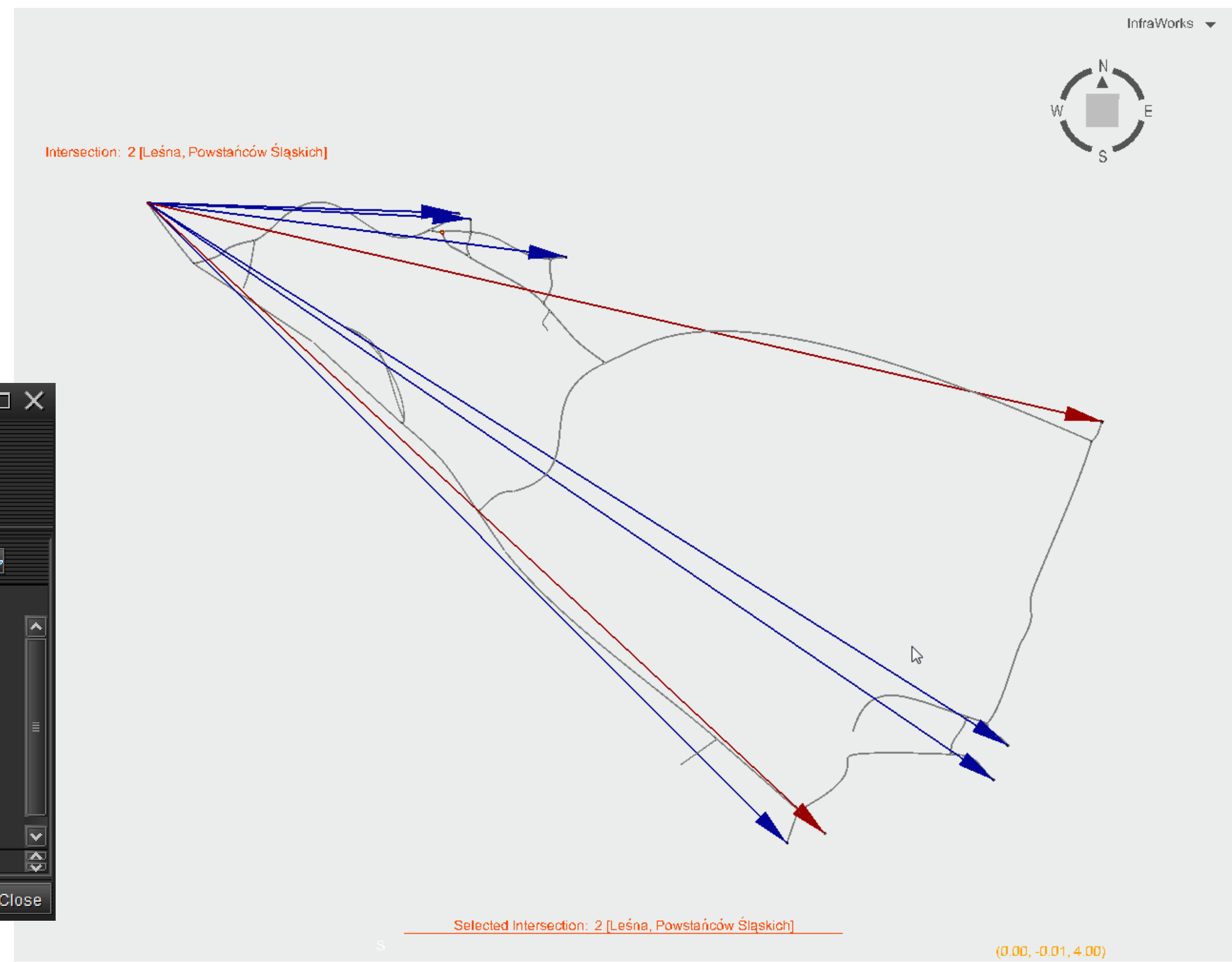
Directed Demand: Origin-Destination Matrices | **Undirected Demand: Origin Volumes**

Volume1

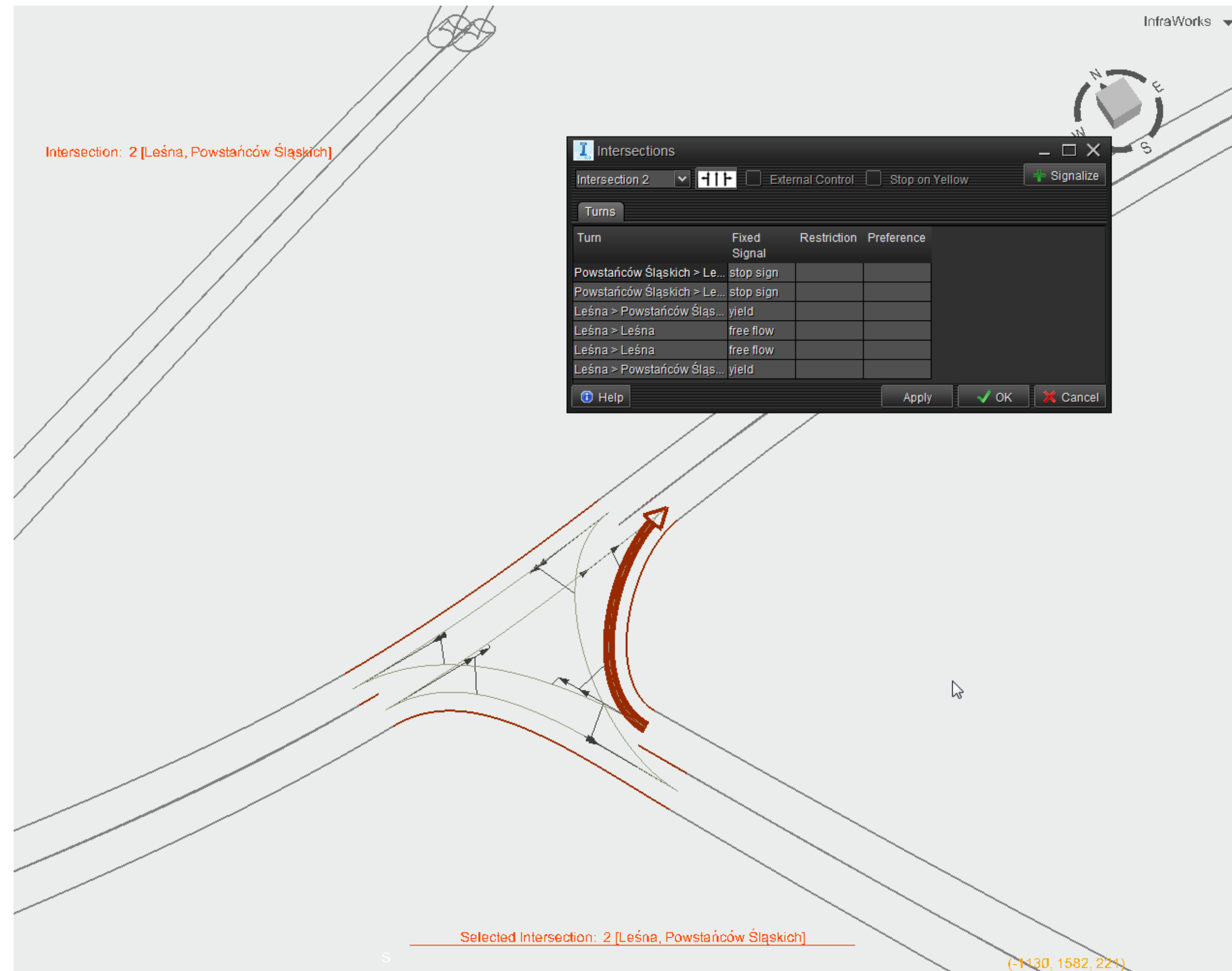
Profile: Simulation | Division: Division | Arrivals:  

Origin Zone	Profile	Demand
Zone 1	Simulation	50
Zone 2	Simulati...	830
Zone 3	Simulation	100
Zone 4	Simulation	250
Zone 5	Simulation	120
Zone 6	Simulation	320
Zone 7	Simulation	830
Zone 8	Simulation	500
Zone 9	Simulation	150
Total		3150

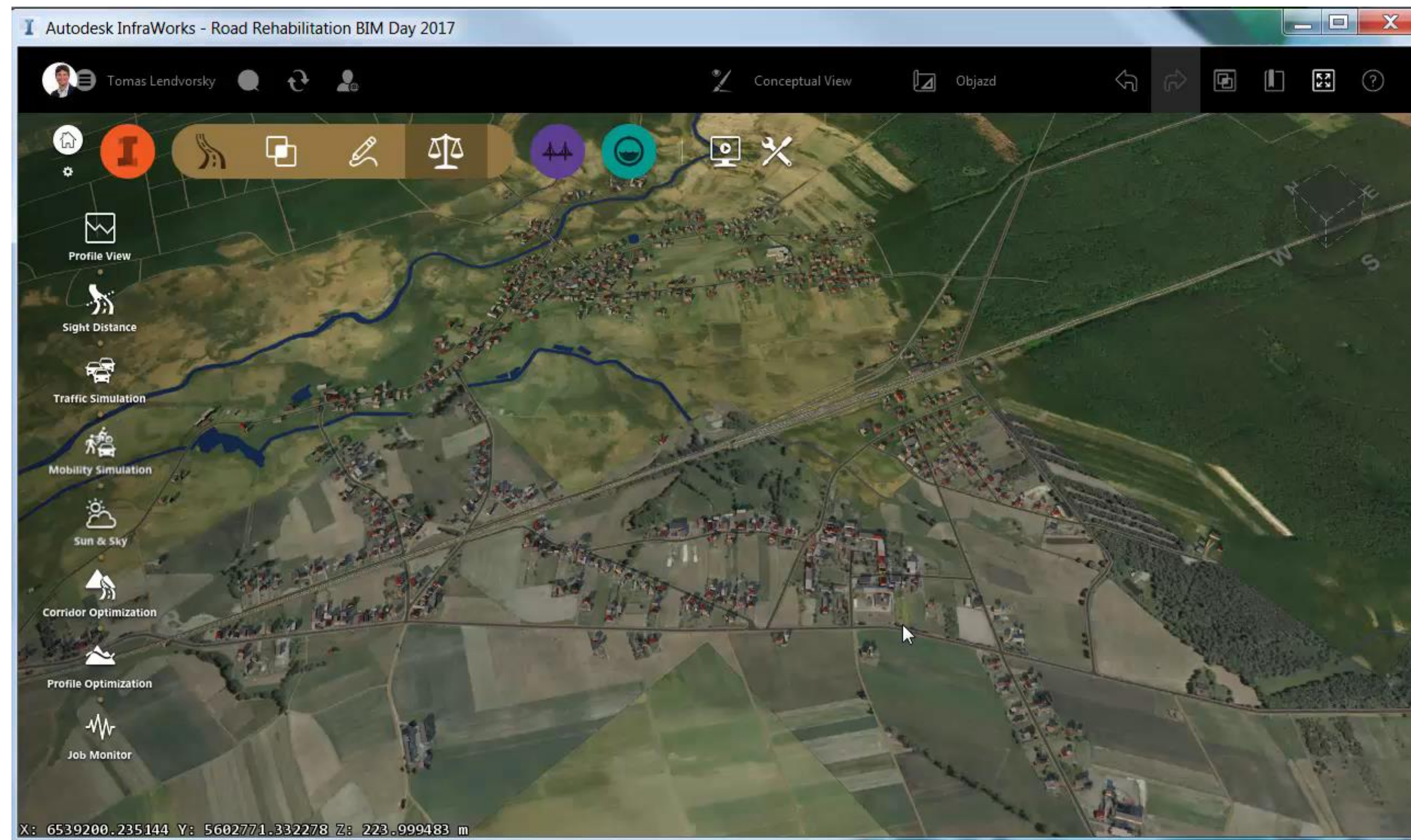
 Help |  OK |  Close



Definition: Intersection Control



Traffic Simulation





Autodesk and the Autodesk logo are registered trademarks or trademarks of Autodesk, Inc., and/or its subsidiaries and/or affiliates in the USA and/or other countries. All other brand names, product names, or trademarks belong to their respective holders. Autodesk reserves the right to alter product and services offerings, and specifications and pricing at any time without notice, and is not responsible for typographical or graphical errors that may appear in this document.

© 2018 Autodesk. All rights reserved.

