Civil 3D Data Mining with Dynamo

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About the speaker

Andrew Milford

- Over 25 years design experience in the Civil Infrastructure industry
- AutoCAD Civil 3D Certified Professional
- Develop processes through scripts, AutoLISP, .NET API (C# and VB) and Python

Class Summary

- **Create custom Civil 3D nodes for Dynamo using C# and the zero-touch interface**
  - Civil Application and Documents
- **Interrogate Civil 3D geometry and models from within Dynamo**
  - Surfaces / Alignments / Profiles
    - Surfaces, Alignment Points, Schedules
- **Extract Civil 3D model data.**
  - Corridors / Baselines / Feature Lines
    - Feature Line Reports
- **Create Civil 3D / CAD geometry from Dynamo**
  - Add 3D Blocks to Civil 3D Model by Station Offset
  - 3D Linemarking for Navisworks

```
/////////////////////////////////////////////////
// Constructor
/////////////////////////////////////////////////

/// <summary>
/// Constructor for a Civil 3D Alignment
/// </summary>
/// <param name="Surface"></param>
internal Alignment(AeccAlignment alignment)
{
    this._alignment = alignment;
    this._entities = alignment.Entities;
    this.Name = alignment.DisplayName;
    this.Length = alignment.Length;
    this.StartStation = alignment.StartingStation;
    this.EndStation= alignment.EndingStation;
}

/////////////////////////////////////////////////
// Methods
/////////////////////////////////////////////////
[MultiReturn (new[] { "Station", "Easting", "Northing"})]
public static Dictionary<string, object> GetAlignmentStations(Alignment Alignment, double Interval, bool Geometry)
{
    AeccAlignmentStations stations = Alignment._alignment.GetStations(AeccStationType.aeccMajor, Interval, 1.0);

    IList<AeccAlignmentStation> stationsList = new List<AeccAlignmentStation>();
    IList<double> s = new List<double>();
    IList<double> e = new List<double>();
    IList<double> n = new List<double>();

    foreach (AeccAlignmentStation station in stations)
    {
        stationsList.Add(station);
    }
```

data mining

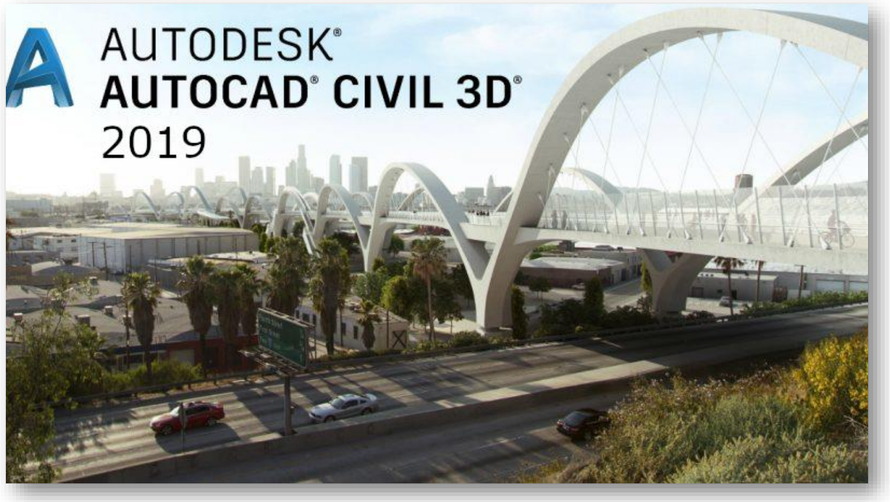
noun COMPUTING

the practice of examining large pre-existing databases in order to generate new information.

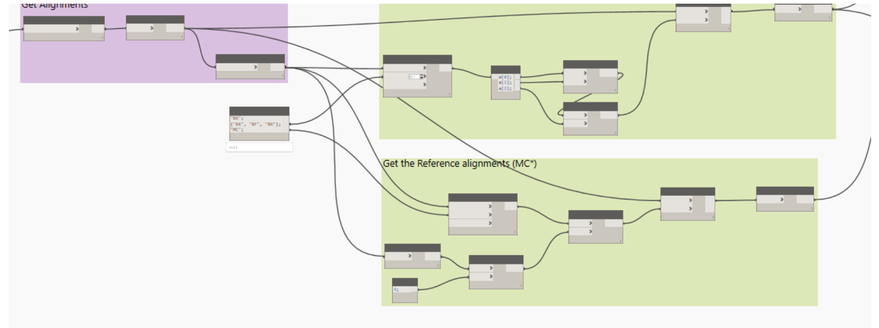
Civil 3D Application

Visual Studio

```
//////////////////////////////////////////////////
// Methods
//////////////////////////////////////////////////

/// <summary>
/// Get the Active Civil 3D Application
/// </summary>
/// <returns></returns>
internal AeccRoadwayApplication GetApplication()
{
    AcadApplication acadApplication = null;
    try
    {
        acadApplication = (AcadApplication)Marshal.GetActiveObject(progID);
    }
    catch
    {
    }

    if (acadApplication != null)
    {
        return acadApplication.GetInterfaceObject(civAppName);
    }

    return null;
}
```



Dynamo

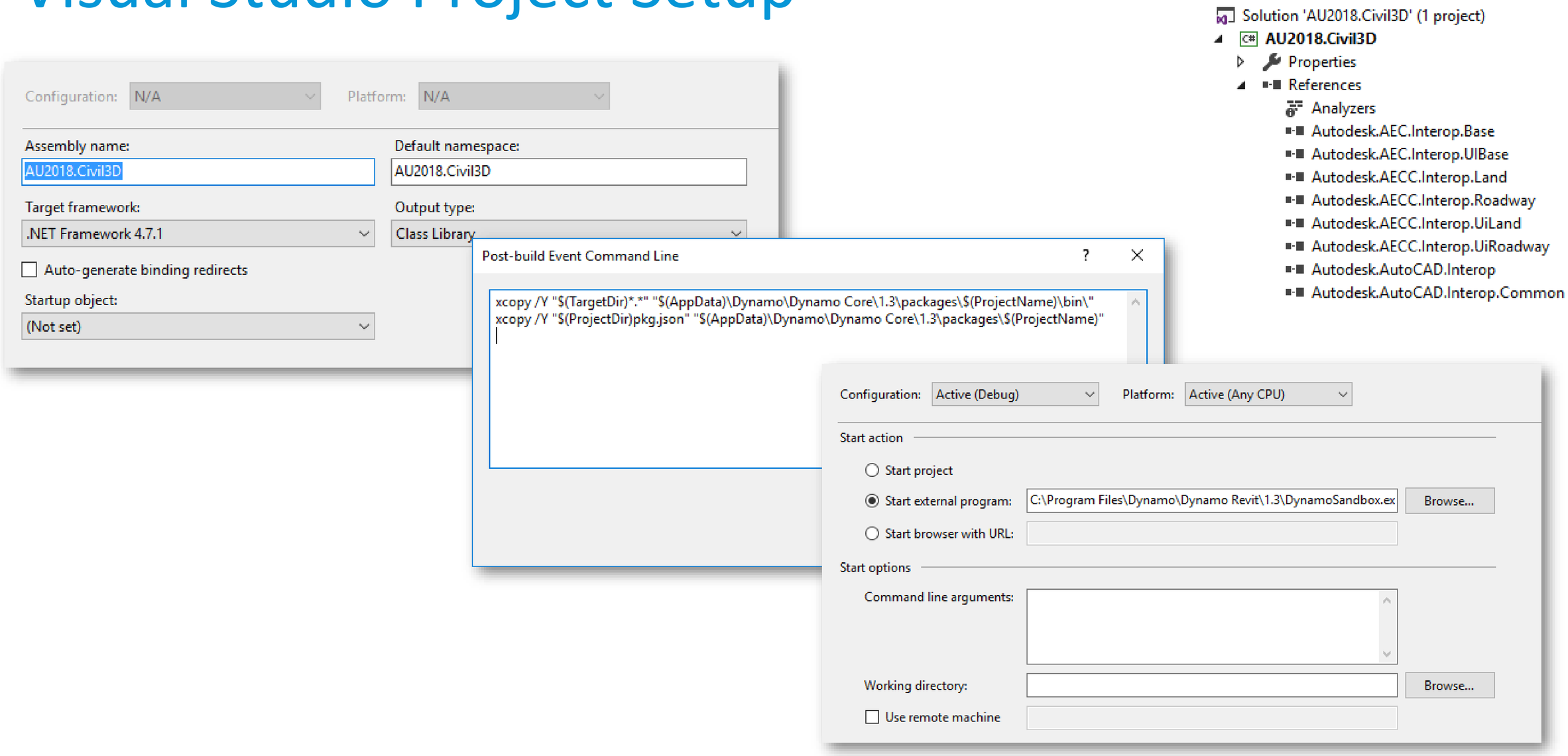


Zero Touch Interface

Connect Civil 3D to Dynamo

- Easy as 1..2..3

Visual Studio Project Setup



Civil 3D to Dynamo in less than 10 lines of code

```
internal AeccRoadwayApplication GetApplication()
{
    AcadApplication acadApplication = null;
    try
    {
        acadApplication = (AcadApplication)Marshal.GetActiveObject("AutoCAD.Application");
    }
    catch
    {
    }

    if (acadApplication != null)
    {
        return acadApplication.GetInterfaceObject("AeccXUiRoadway.AeccRoadwayApplication.13.0");
    }

    return null;
}`
```

Civil 3D Documents in less than 5 lines

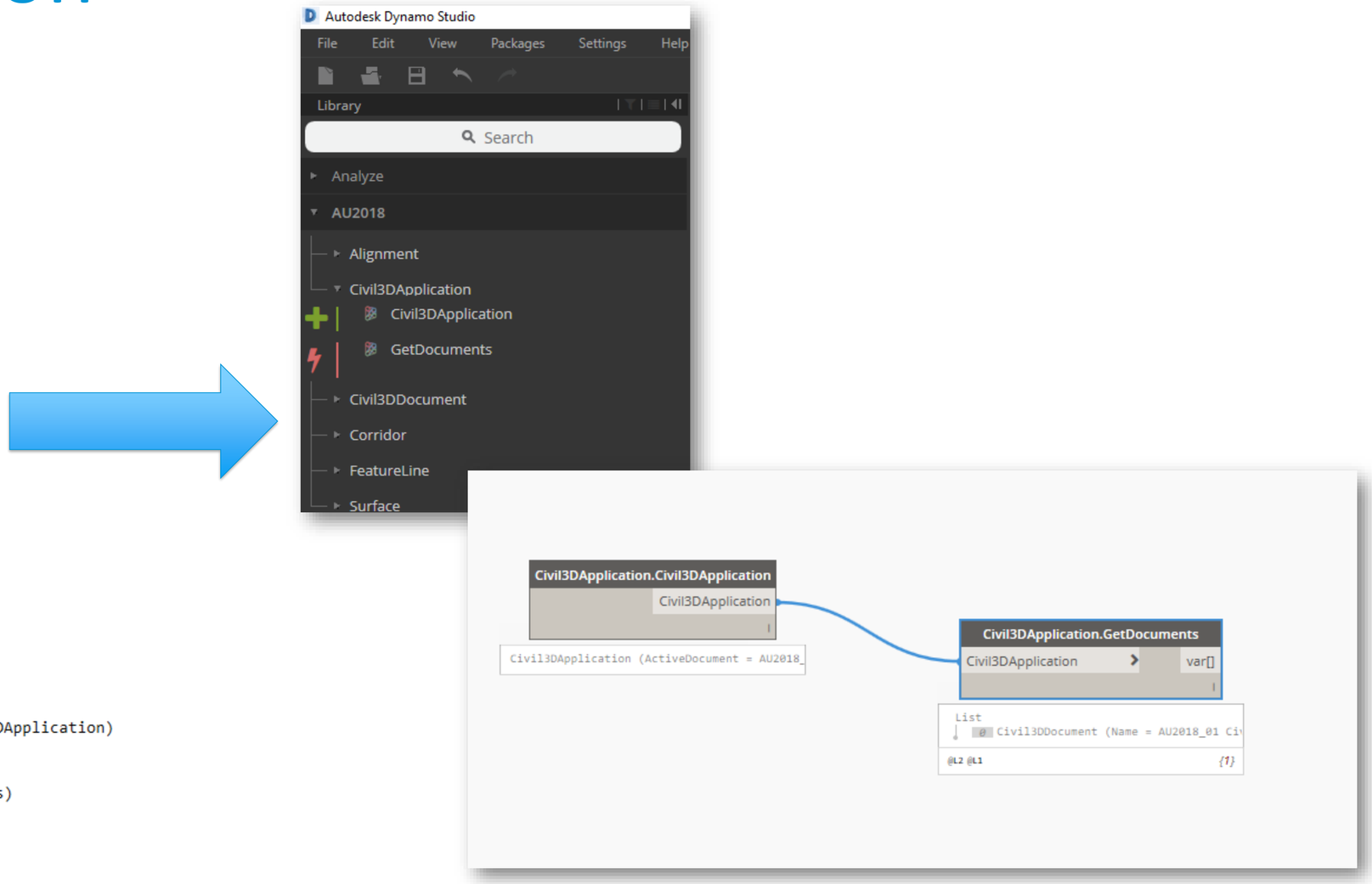
```
public static IList<Civil3DDocument> GetDocuments(Civil3DApplication Civil3DApplication)
{
    IList<Civil3DDocument> docsList = new List<Civil3DDocument>();

    foreach (AeccRoadwayDocument doc in Civil3DApplication._civApp.Documents)
    {
        docsList.Add(new Civil3DDocument(doc as AeccRoadwayDocument));
    }

    return docsList;
}
```

Override ‘ToString’ Method

```
/// <summary>
/// Override the string output for the CivilApplication object
/// </summary>
/// <returns></returns>
public override string ToString()
{
    return string.Format($"Civil3DApplication (ActiveDocument = {this._activeDocument.Name})");
}
```

Test your application

```
/// <summary>
/// Get the active Civil 3D Application
/// </summary>
/// <returns></returns>
internal AeccRoadwayApplication GetApplication()
{
    AcadApplication acadApplication = null;
    try
    {
        acadApplication = (AcadApplication)Marshal.GetActiveObject(progID);
    }
    catch
    {
    }

    if (acadApplication != null)
    {
        return acadApplication.GetInterfaceObject(civAppName);
    }

    return null;
}
```

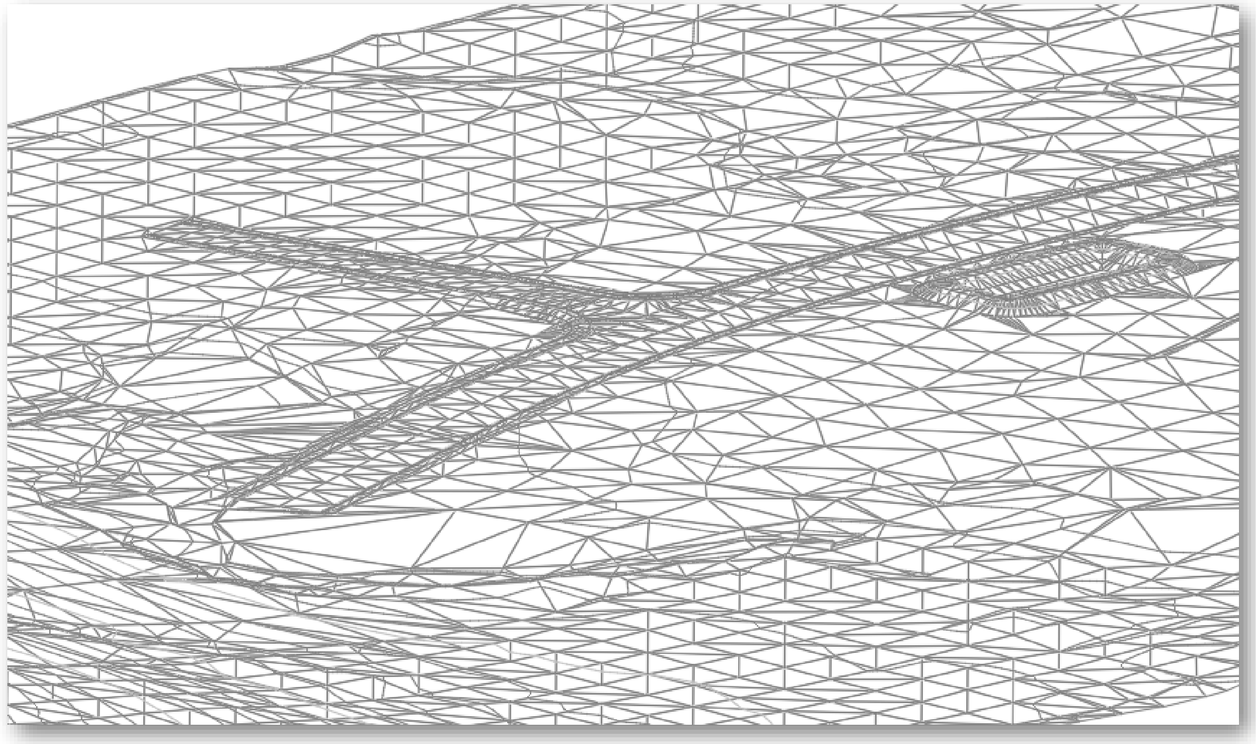


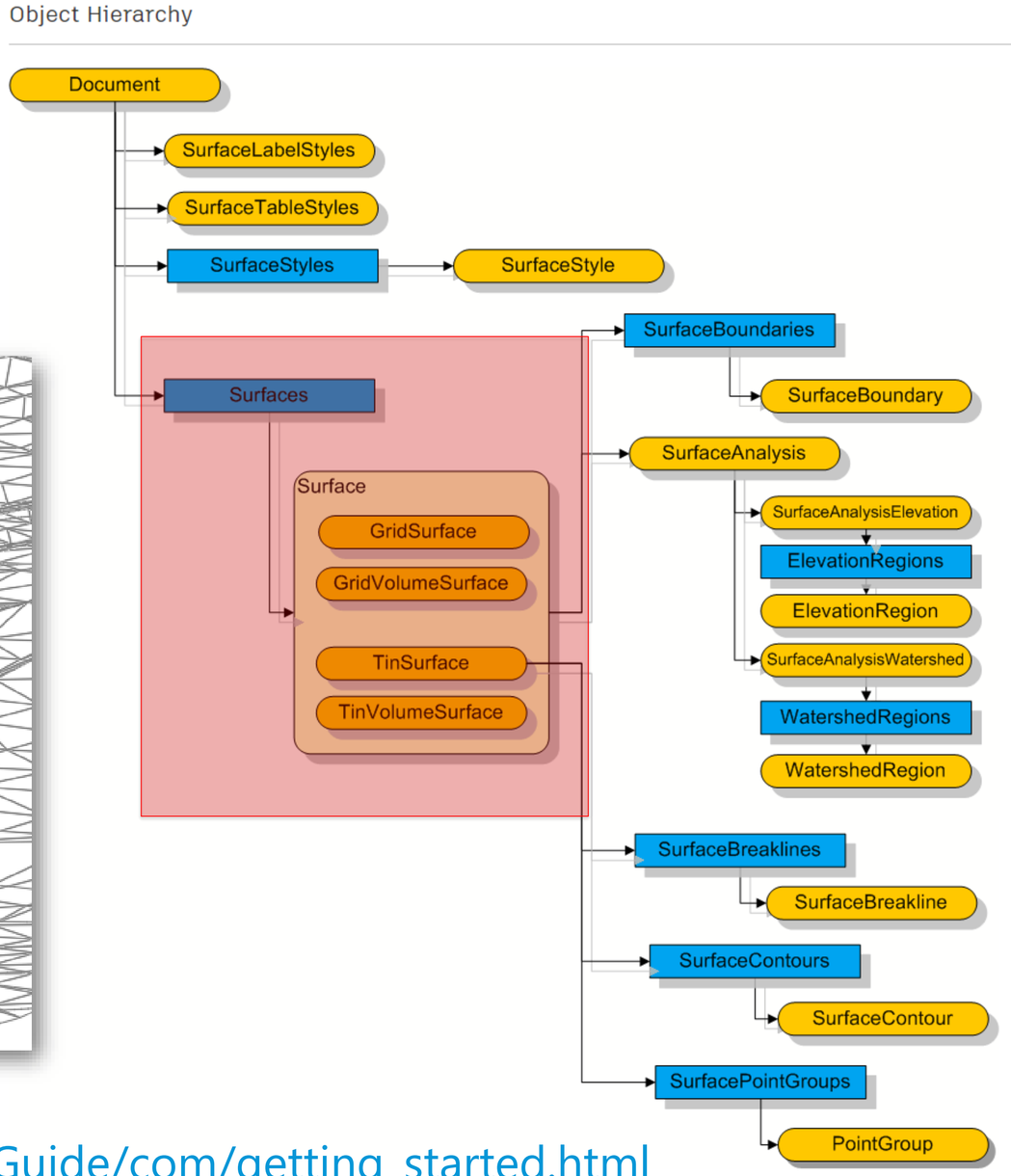

```
/// <summary>
/// Return a list of all the open Documents
/// </summary>
/// <param name="Civil3DApplication"></param>
/// <returns></returns>
public static IList<Civil3DDocument> GetDocuments(Civil3DApplication Civil3DApplication)
{
    IList<Civil3DDocument> docsList = new List<Civil3DDocument>();
    foreach (AeccRoadwayDocument doc in Civil3DApplication._civApp.Documents)
    {
        docsList.Add(new Civil3DDocument(doc as AeccRoadwayDocument));
    }
    return docsList;
}
```

Interrogate the Civil 3D model

- Surfaces, Alignments and Profiles

Civil 3D Surfaces





http://docs.autodesk.com/CIV3D/2012/ENU/API_Reference_Guide/com/getting_started.html

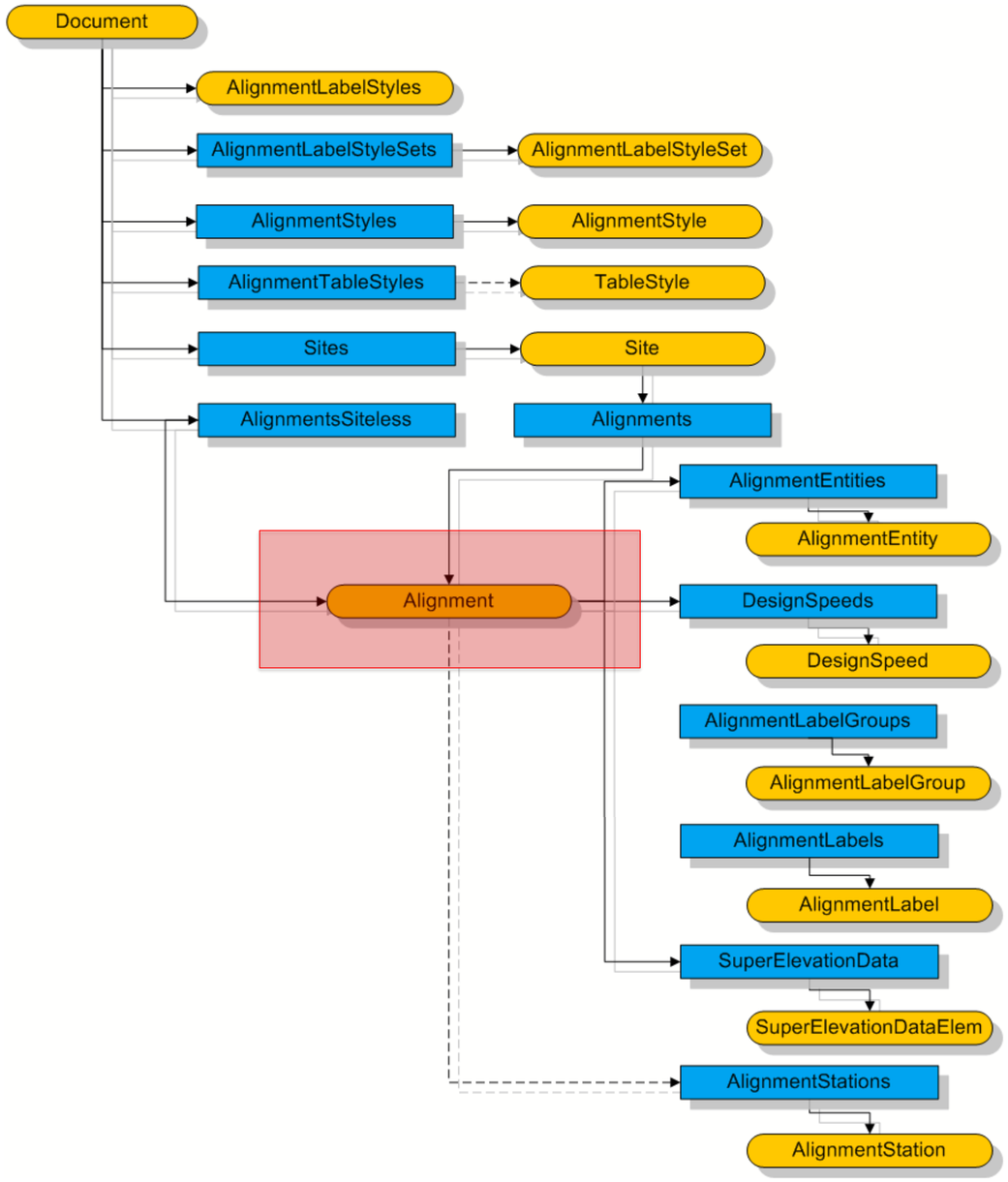
http://help.autodesk.com/view/CIV3D/2019/ENU/?guid=GUID-DA303320-B66D-4F4F-A4F4-9FBBEC0754E0

Civil 3D Alignments

	A	B	C	D	E	F	G
1	Station	Easting	Northing	Elevation			
2	0	501144.3	6619823	23.26923			
3	5	501145.7	6619818	23.43241			
4	10	501147	6619813	23.59548			
5	15	501148.4	6619808	23.74185			
6	20	501149.7	6619804	23.85971			
7	25	501151	6619799	23.94903			
8	30	501152.4	6619794	24.00983			
9	35	501153.7	6619789	24.0421			
10	40	501155.1	6619784	24.04585			
11	45	501156.4	6619779	24.02107			
12	50	501157.7	6619775	23.96777			
13	55	501159.1	6619770	23.88899			

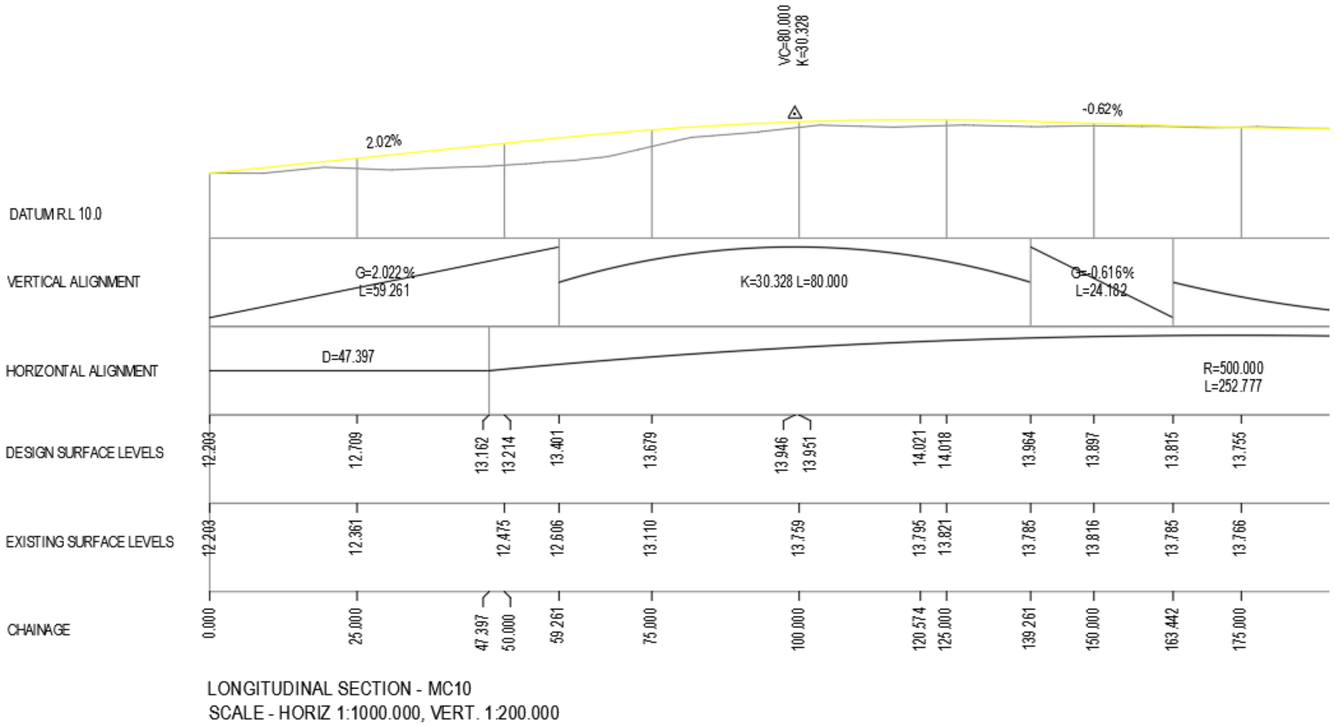
MC10 | MC20 | MC30 | MC40 | **MC50**

Object Hierarchy



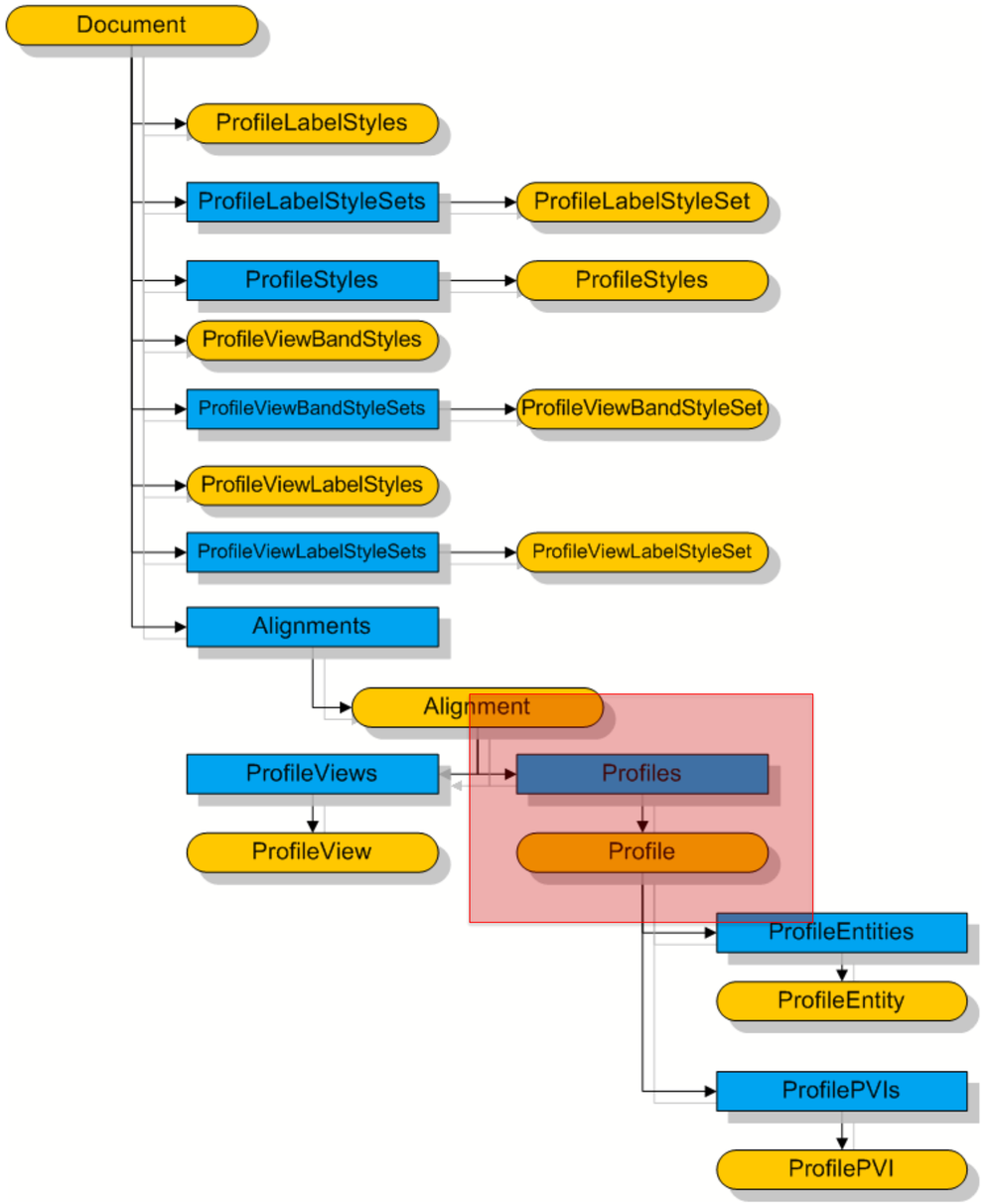
COM API Alignment Object Model

Civil 3D Profiles



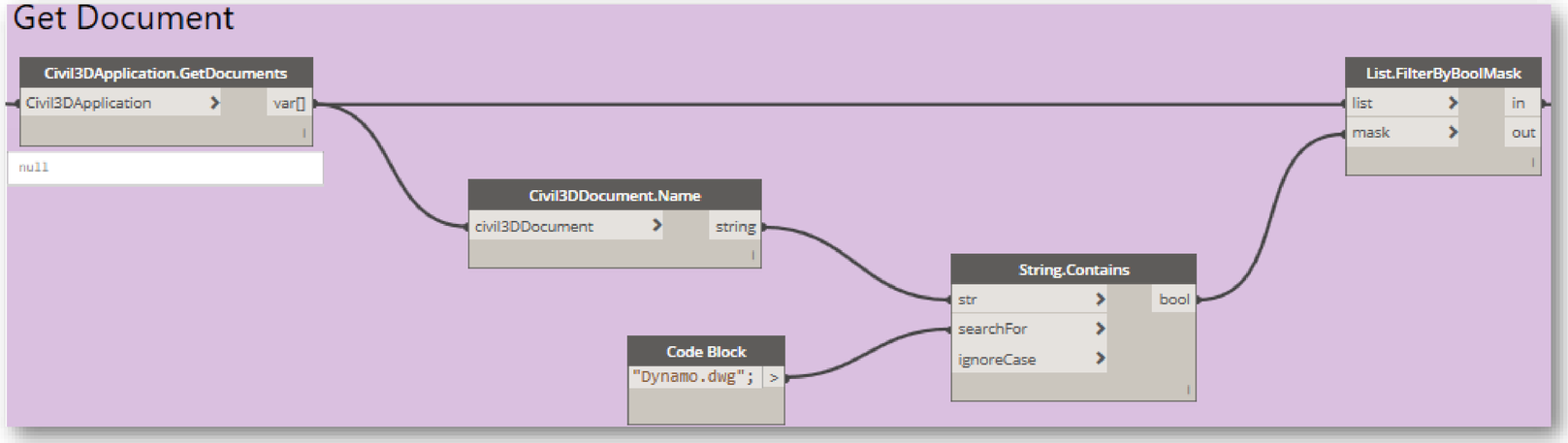
LONGITUDINAL SECTION - MC10
SCALE - HORIZ 1:1000.000, VERT. 1:200.000

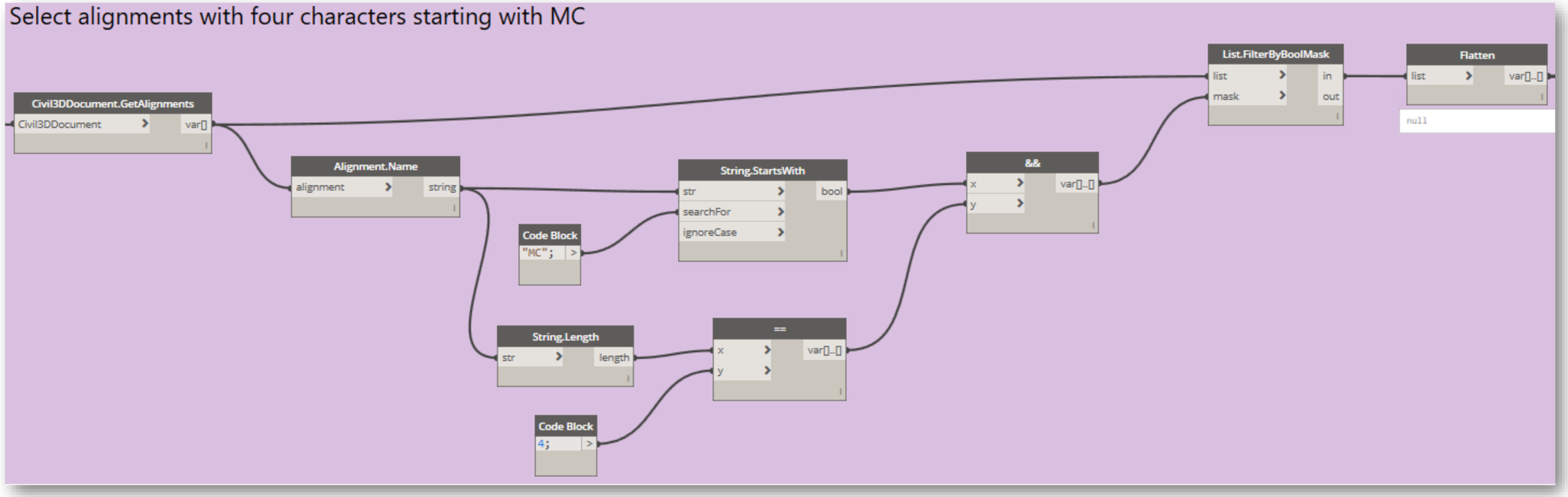
Object Hierarchy



Profile Object Model

Dynamo Snippets





Visualise your data

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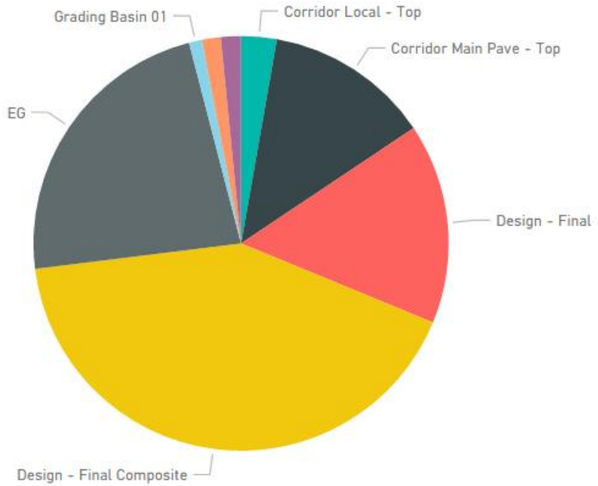
Name	NumTris	NumPoints
Temp Planes - Top	740	531
Grading Basin 02	692	400
Grading Basin 01	480	299
EG	10859	5776
Design - Final Composite	19808	10265
Design - Final	7396	4040
Corridor Main Pave - Top	6086	3325
Corridor Local - Top	1310	760
Total	**47371**	**25396**

NumTris by Name



NumPoints and Maximum Points

Name

- [ ] Corridor Local - Top
- [ ] Corridor Main Pave - Top
- [ ] Design - Final
- [ ] Design - Final Composite
- [ ] EG
- [ ] Grading Basin 01
- [ ] Grading Basin 02
- [ ] Temp Planes - Top

Alignment reports

Alignment Incremental Station Report

Client: **Prepared by:**

Client Preparer

Client Company Your Company Name

Address 1 123 Main Street

Date: 10/24/2018 11:05:02 PM

Alignment Name: MC10

Description:

Station Range: Start: 0.000, End: 850.000

Station Increment: 20.00

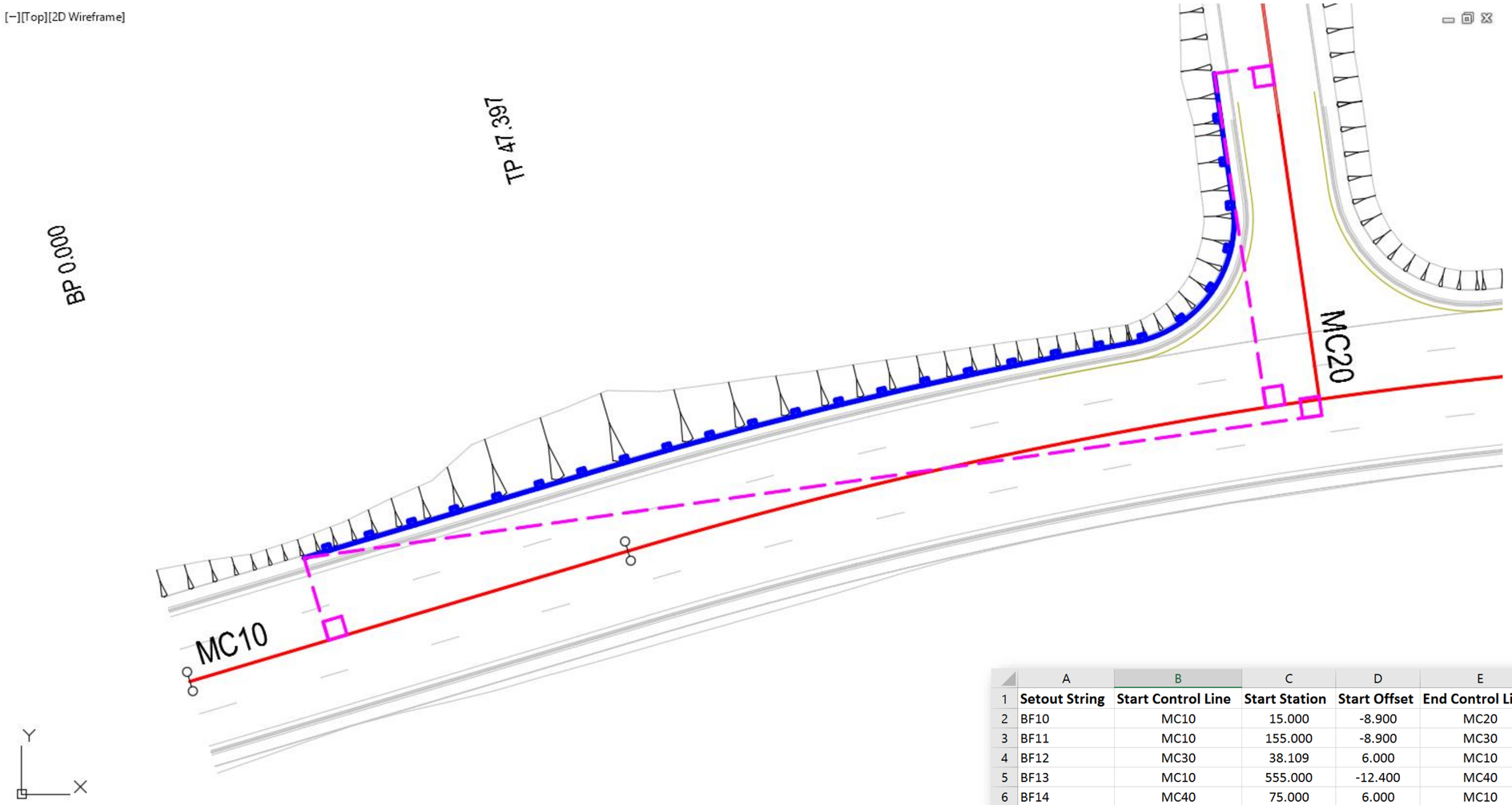
Station	Northing	Easting	Tangential Direction
0	6,619,836.701m	500,521.859m	N 73° 24' 50.95"
20	6,619,842.410m	500,541.027m	N 73° 24' 50.95"
40	6,619,848.119m	500,560.195m	N 73° 24' 50.95"
60	6,619,853.675m	500,579.407m	N 74° 51' 30.12"
80	6,619,858.512m	500,598.811m	N 77° 09' 00.71"
100	6,619,862.569m	500,618.394m	N 79° 26' 31.30"
120	6,619,865.839m	500,638.124m	N 81° 44' 01.89"
140	6,619,868.318m	500,657.968m	N 84° 01' 32.48"
160	6,619,870.001m	500,677.896m	N 86° 19' 03.08"
180	6,619,870.886m	500,697.875m	N 88° 36' 33.67"
200	6,619,870.972m	500,717.874m	N 90° 54' 04.26"
220	6,619,870.257m	500,737.859m	N 93° 11' 34.85"

	A	B	C	D
1	Station	Easting	Northing	Elevation
2	0	500521.9	6619837	12.20335
3	5	500526.7	6619838	12.30443
4	10	500531.4	6619840	12.40551
5	15	500536.2	6619841	12.5066
6	20	500541	6619842	12.60768
7	25	500545.8	6619844	12.70876
8	30	500550.6	6619845	12.80985
9	35	500555.4	6619847	12.91093
10	40	500560.2	6619848	13.01201
11	45	500565	6619850	13.1131
12	47.39686	500567.3	6619850	13.16155
13	50	500569.8	6619851	13.21418
14	55	500574.6	6619852	13.31527
15	60	500579.4	6619854	13.41626
16	65	500584.2	6619855	13.512
17	70	500589.1	6619856	13.5995
18	75	500593.9	6619857	13.67876
19	80	500598.8	6619859	13.74977

Barrier Schedule

ZONE 1 SAFETY BARRIER SCHEDULE												
LABEL			SETOUT STRING	START CONTROL LINE	START STATION	END CONTROL LINE	END STATION	BARRIER TYPE	TERMINAL START	TERMINAL END	LENGTH	DRAWING NUMBER	COMMENTS
SB	1	01	NOT USED										
SB	1	02	NOT USED										
SB	1	03	BXD1	M110	12835.000	M110	13115.897	VERGE SWR	T1	T1	281.894	HEX-RF-21-D101, 102	HEX D&C CONTRACTOR TO CONSTRUCT PART LENGTH OF VERGE SWR IN THE ALLIANCE SECTION
SB	1	04	BX1J	M110	13020.012	M110	14580.000	MEDIAN SWR	T1	T1	1558.105	HEX-RF-21-D101, 102,103, 104,105,106,107	
SB	1	05	BXA0	M1A0	18.870	M1A0	272.507	VERGE SWR	T1	T7	253.400	HEX-RF-21-D102, 103	
SB	1	06	BFA1	M1A0	262.929	M1F0	120.497	G4 W-BEAM	T7	T4	465.992	HEX-RF-21-D 103, 104, 134	REFER TO NOTE 3
SB	1	6A	NOT USED										
SB	1	07	BFD0	M1E0	85.835	M1D0	341.964	G4 W-BEAM	T2	T4	436.790	HEX-RF-21-D 103, 104, 136	
SB	1	7A	NOT USED										
SB	1	08	BX11	M110	13646.700	M110	13706.700	VERGE SWR	T1	T1	60.000	HEX-RF-21-D104	REFER TO NOTE 6
SB	1	09	BS20	M110	13694.500	M110	13895.500	TYPE-F (SS820)	T6	T9	200.746	HEX-RF-21-D104	REFER TO NOTES 5 & 6
SB	1	10	BS2I	M110	13747.200	M110	13945.500	TYPE-F (SS820)	T9	T6	199.280	HEX-RF-21-D104, 105	REFER TO NOTES 5 & 6
SB	1	11	BF90	M1D0	38.230	M190	36.034	G4 W-BEAM	T4	T5	30.207	HEX-RF-21-D104	REFER TO NOTE 8
SB	1	12	BFF1	M1G0	146.900	M1B0	84.663	G4 W-BEAM	T2	T7	322.089	HEX-RF-21-	
SB	1	13	BG9J	M190	108.926	M190	219.928	G4 W-BEAM	T5	T5	104.296	HEX-RF	
SB	1	14	BG9I	M190	306.633	M190	27.674	G4 W-BEAM	T5	T5	104.742	HEX-RF	
SB	1	15	BF91	M1B0	43.460	M190	227.904	G4 W-BEAM	T4	T5	31.994	HEX-RF	
SB	1	16	BFC1	M1C0	469.629	M1E0	49.360	G4 W-BEAM	T7	T4	258.160	HEX-RF-21-	
SB	1	16A	NOT USED										
SB	1	17	BXB1	M1B0	74.928	M110	15007.143	VERGE SWR	T7	T1	1067.375	HEX-RF-21-D	
SB	1	18	BXC0	M110	14955.742	M1C0	479.191	VERGE SWR	T1	T7	975.899	HEX-RF-21-D	
SB	1	19	BX2I	M110	13933.300	M110	13993.300	VERGE SWR	T1	T1	60.680	HEX-RF	
SB	1	20	BX1L	M110	14620.000	M110	15479.988	MEDIAN SWR	T1	T1	858.092	HEX-RF-21-D1	
SB	1	21	BS22	M110	14994.500	M110	15080.400	TYPE-F (SS820)	T6	T9	85.003	HEX-RF-2	
SB	1	22	NOT USED										
SB	1	23	BFH1	M1H0	115.770	M1H0	129.502	G4 W-BEAM	T5	T4	13.999	HEX-RF	
SB	1	24	BS2K	M110	15045.300	M110	15125.500	TYPE-F (SS820)	T9	T6	81.177	HEX-RF	

Civil 3D Barriers

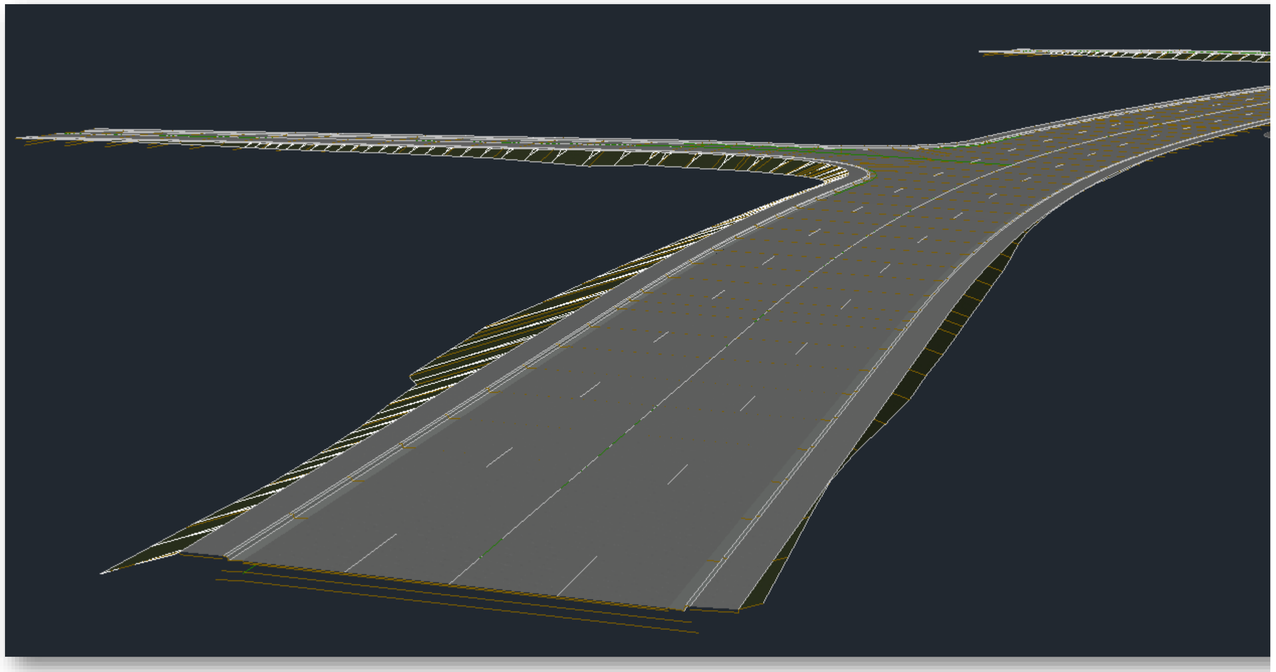


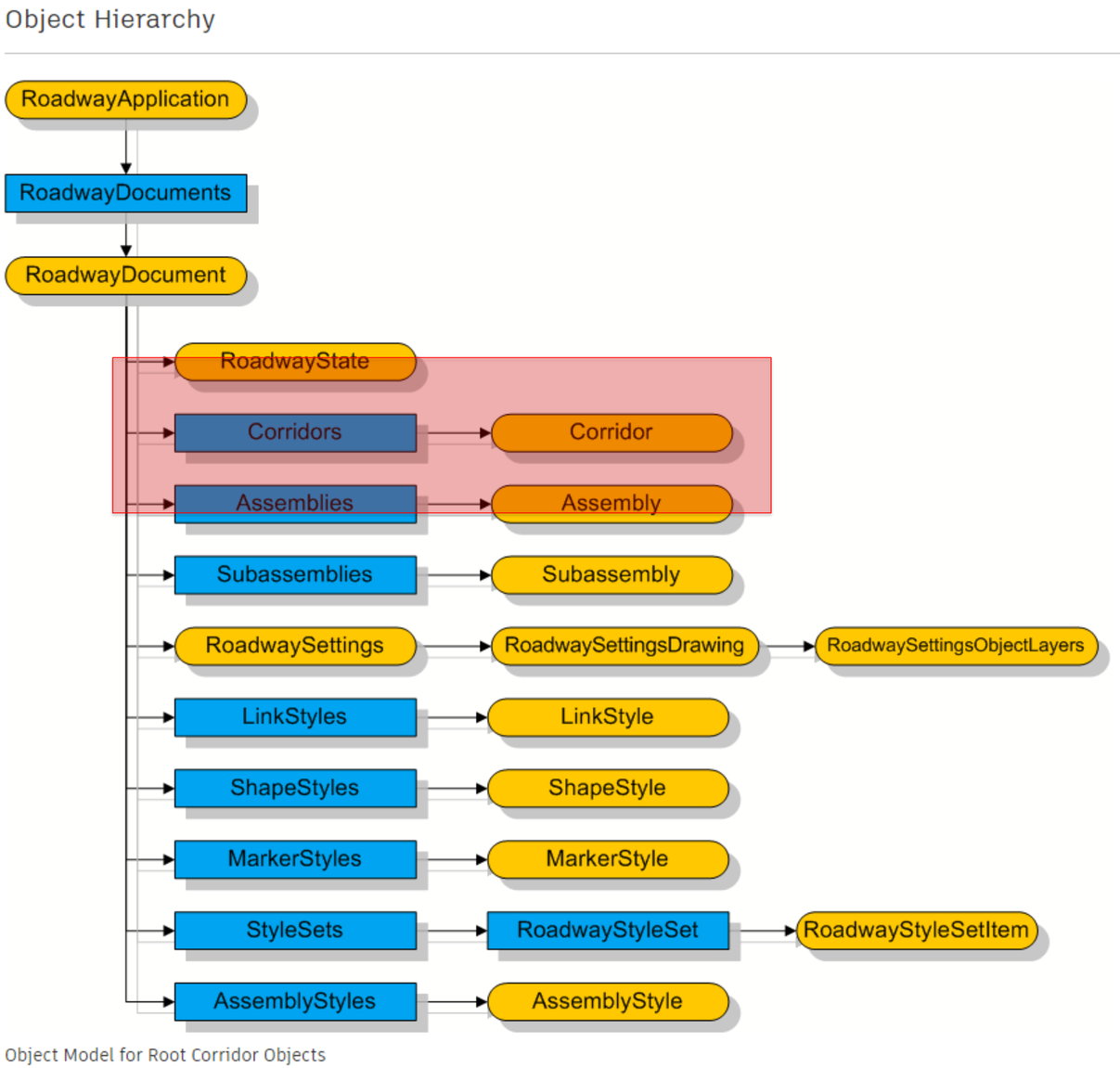
	A	B	C	D	E	F	G	H	I
1	**Setout String**	**Start Control Line**	**Start Station**	**Start Offset**	**End Control Line**	**End Station**	**End Offset**	**Barrier Type**	**Length**
2	BF10	MC10	15.000	-8.900	MC20	35	-6	GUARD FENCE LHS	122.144
3	BF11	MC10	155.000	-8.900	MC30	38.109167	-6	GUARD FENCE LHS	176.752
4	BF12	MC30	38.109	6.000	MC10	403.4201082	-8.9	GUARD FENCE LHS	109.695
5	BF13	MC10	555.000	-12.400	MC40	50	-6	GUARD FENCE LHS	100.622
6	BF14	MC40	75.000	6.000	MC10	809.006307	-8.9	GUARD FENCE LHS	225.997
7	BX1I	MC10	156.447	8.900	MC10	259.8281054	8.900000001	WIRE ROPE	101.541
8	BX1J	MC10	330.195	8.900	MC10	490	8.9	WIRE ROPE	160.735
9	BG1K	MC10	595.000	8.900	MC50	55	6	GUARD FENCE RHS	74.632
10	BG1L	MC50	40.000	-6.000	MC10	735	8.900000001	GUARD FENCE RHS	120.524

Extracting Civil 3D Model Data

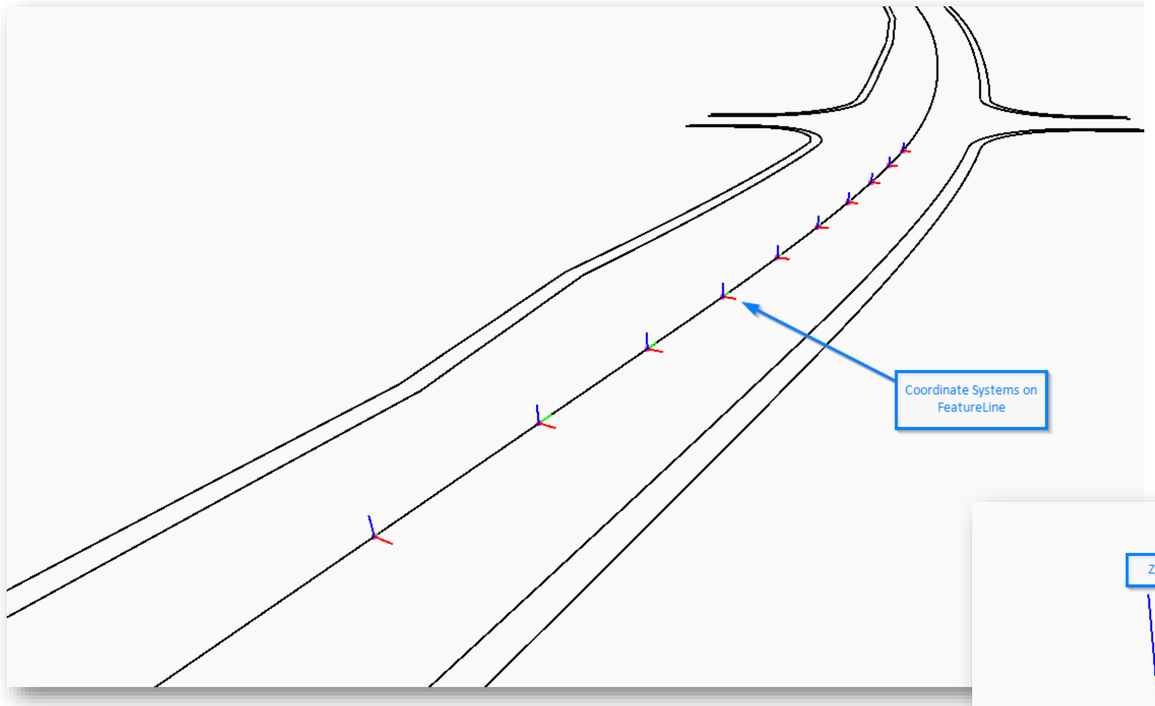
- Corridors, Baselines and Feature Lines

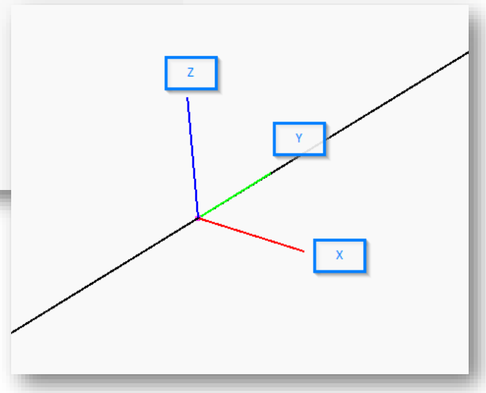
Civil 3D Corridors





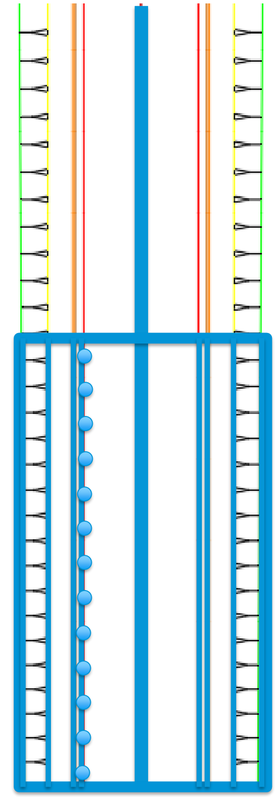
Civil 3D Baselines & Feature Lines



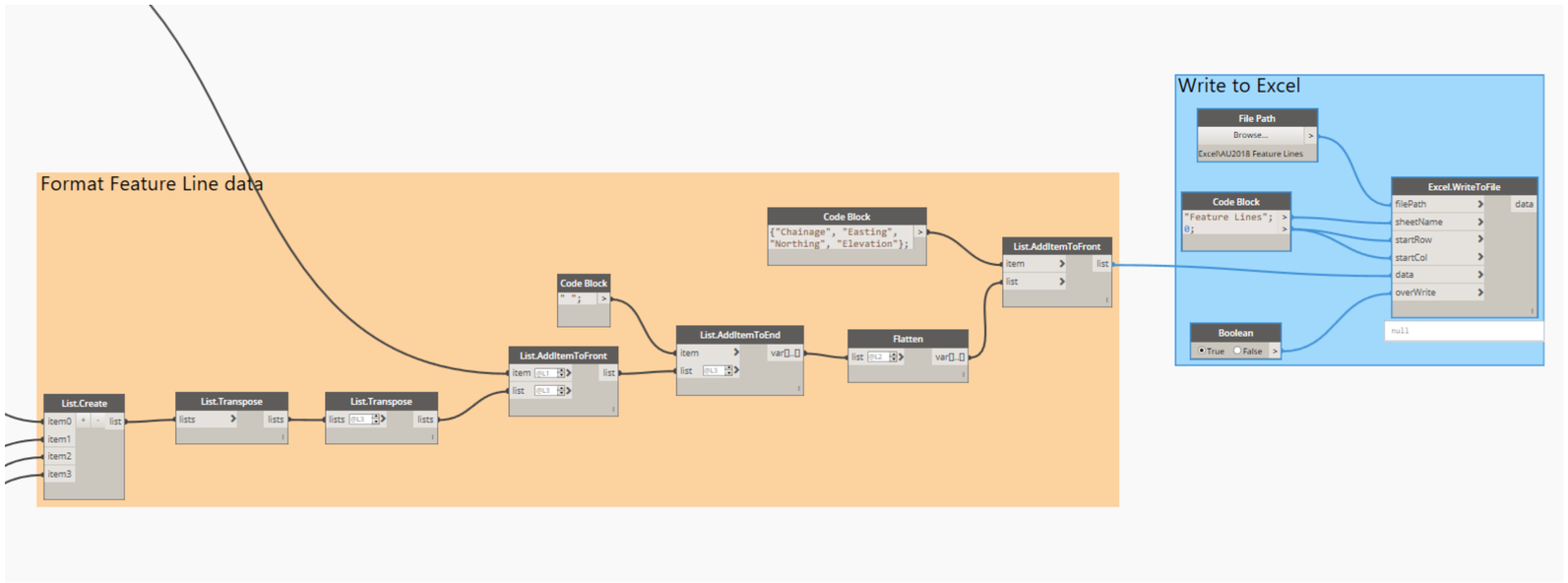


Civil 3D Feature Lines

```
public IList<FeatureLine> GetFeatureLines(string Code)
{
    IList<FeatureLine> fLinesColl = new List<FeatureLine>();

    foreach (AeccBaseline baseline in this._corridor.Baselines)
    {
        foreach (AeccBaselineRegion baselineRegion in baseline.BaselineRegions)
        {
            foreach (AeccFeatureLines flines in baseline.MainBaselineFeatureLines.FeatureLinesCol)
            {
                foreach (AeccFeatureLine fline in flines)
                {
                    if (fline.CodeName == Code)
                    {
                        IList<Point> points = new List<Point>();
                        IList<double> chainages = new List<double>();

                        foreach (AeccFeatureLinePoint pt in fline.FeatureLinePoints)
                        {
                            Point ptDyn = Point.ByCoordinates(pt.XYZ[0], pt.XYZ[1], pt.XYZ[2]);

                            if (pt.Station >= baselineRegion.StartStation && pt.Station <= baselineRegion.EndStation)
                            {
                                points.Add(ptDyn);
                                chainages.Add(pt.Station);
                            }
                        }
                        PolyCurve curve = PolyCurve.ByPoints(points);
                        fLinesColl.Add(new FeatureLine(baseline, baselineRegion, fline, curve, points, chainages));
                    }
                }
            }
        }

    }
    return fLinesColl;
}
```



Create Feature Line Report



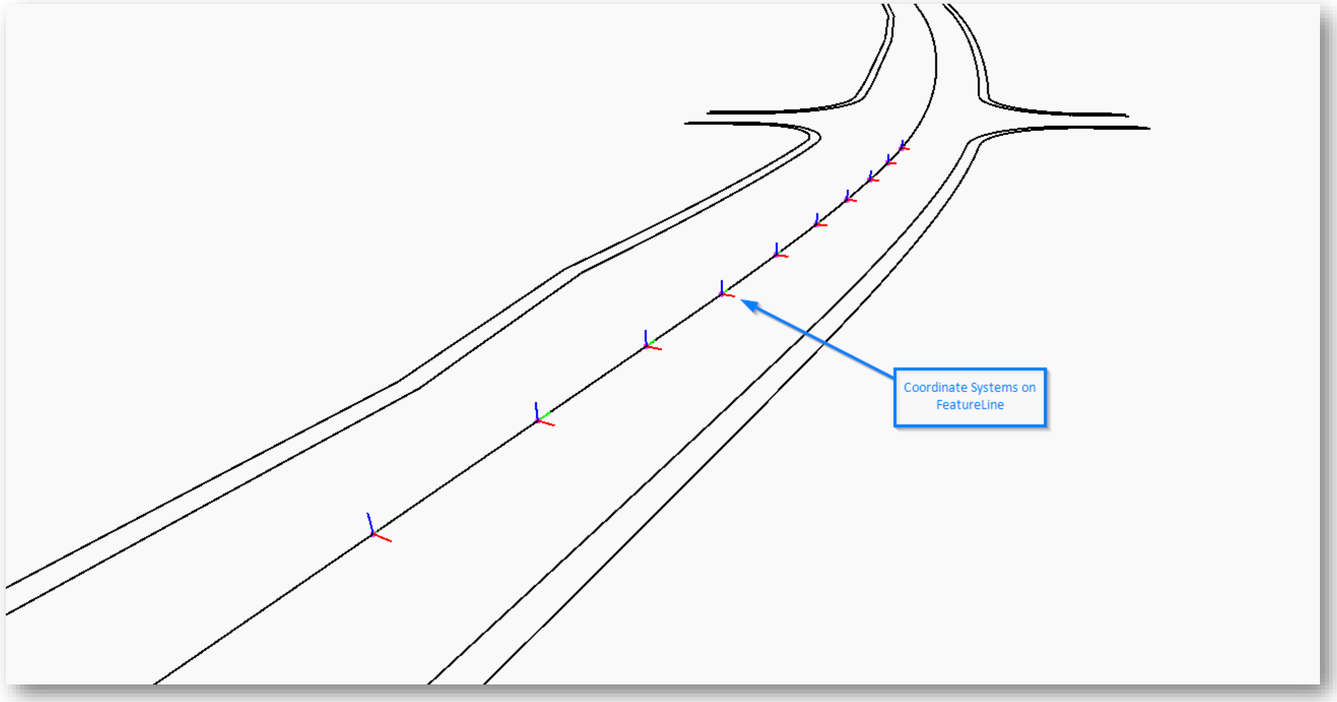
	A	B	C	D
1	Chainage	Easting	Northing	Elevation
2	Featureline NL			
3	0	500522	6619837	12.2033
4	5	500527	6619838	12.3044
5	10	500531	6619840	12.4055
6	15	500536	6619841	12.5066
7	20	500541	6619842	12.6077
8	25	500546	6619844	12.7088
9	30	500551	6619845	12.8098
10	35	500555	6619847	12.9109
11	40	500560	6619848	13.012
12	45	500565	6619850	13.1131
13	47.397	500567	6619850	13.1616
14	50	500570	6619851	13.2142
15	55	500575	6619852	13.3153
16	60	500579	6619854	13.4163
17	65	500584	6619855	13.512
18	70	500589	6619856	13.5995
19	75	500594	6619857	13.6788
20	80	500599	6619859	13.7498
21	85	500604	6619860	13.8125
22	90	500609	6619861	13.8671
23	95	500613	6619862	13.9134
24	100	500618	6619863	13.9514
25	105	500623	6619863	13.9812
26	110	500628	6619864	14.0027

Feature Lines | Sheet1

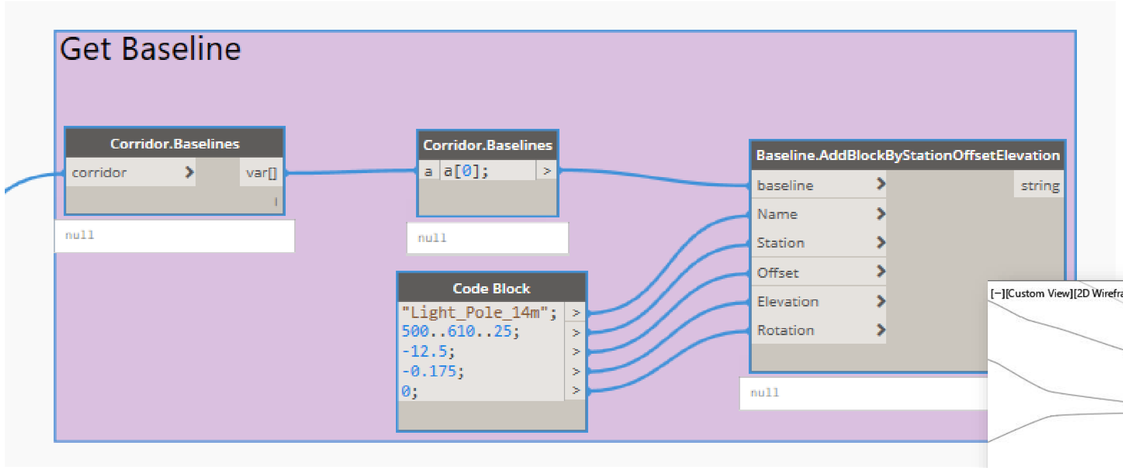
Dynamo to Civil 3D / AutoCAD

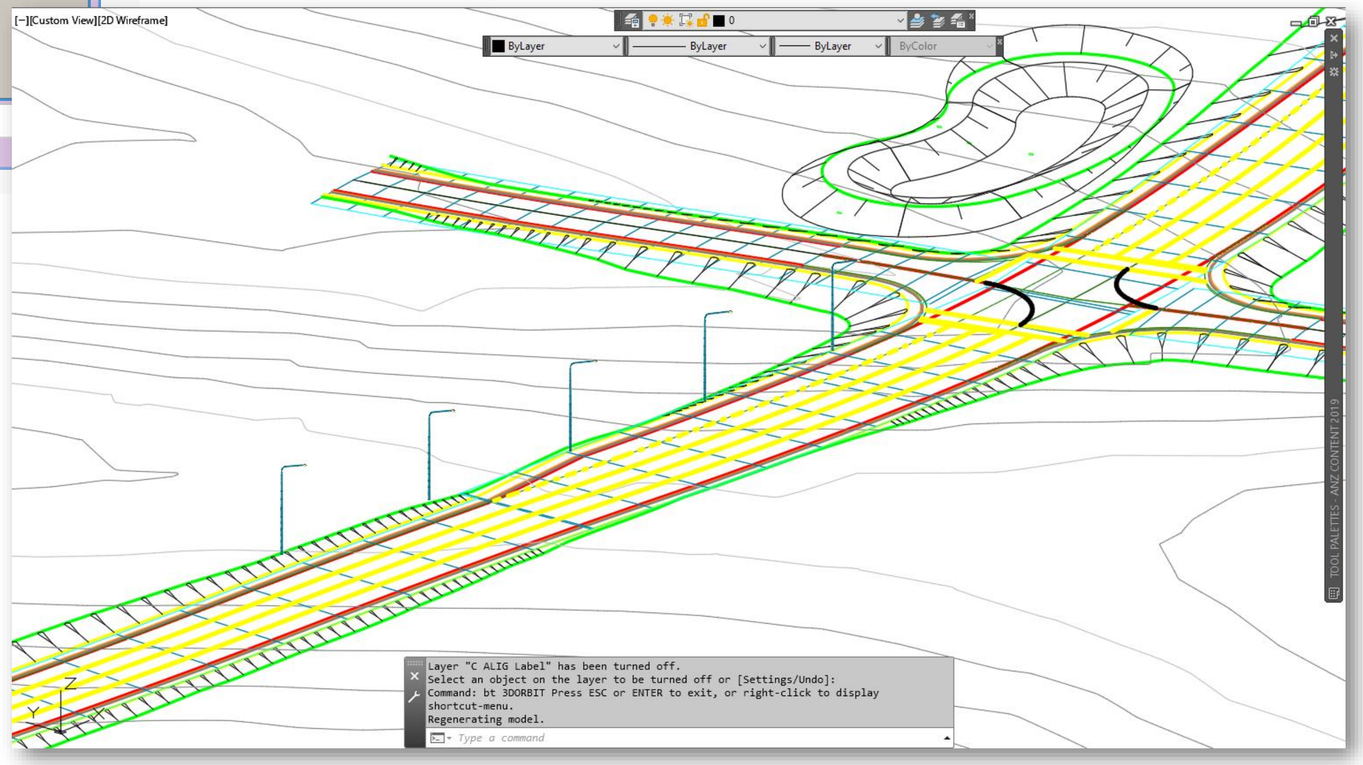
- Object placement by XYZ
- Object placement through Excel
- 3D Linemarking

Road Furniture Placement



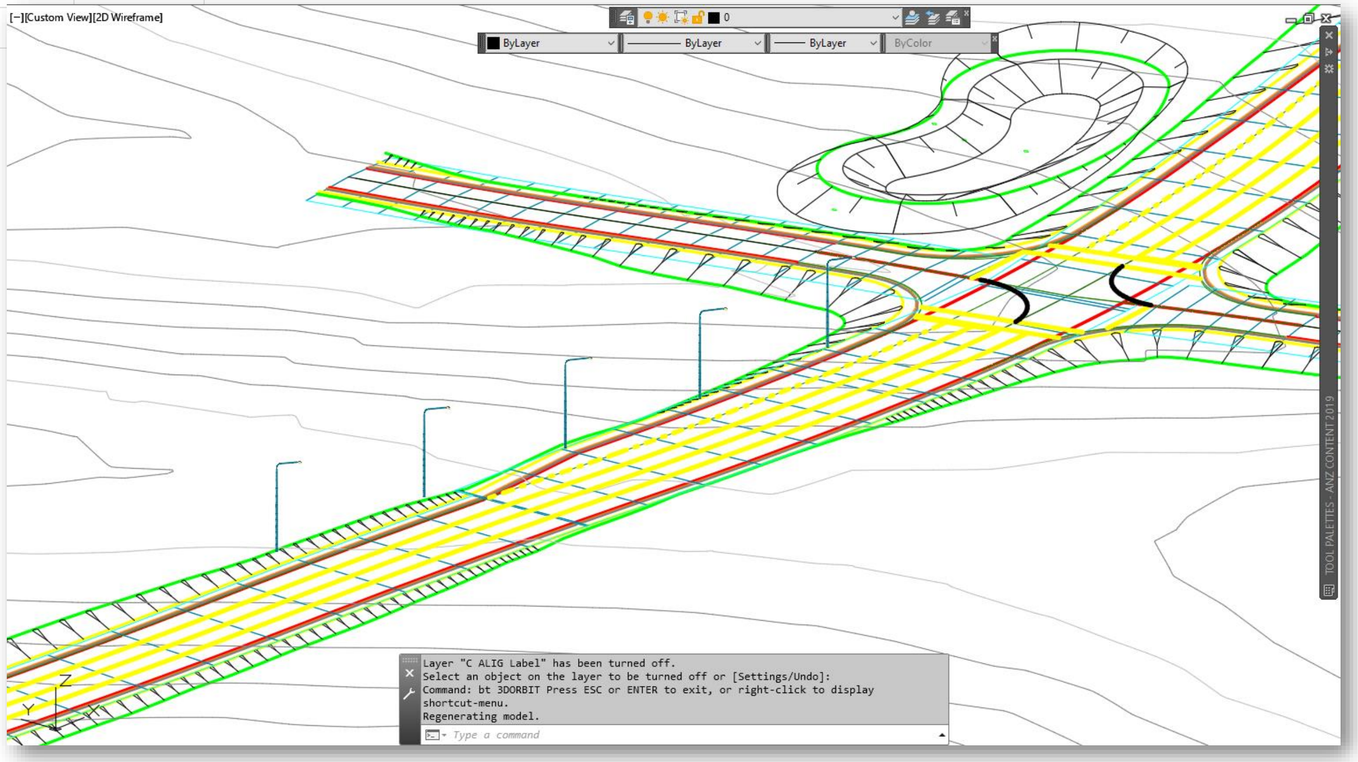
Creating Objects from Baseline



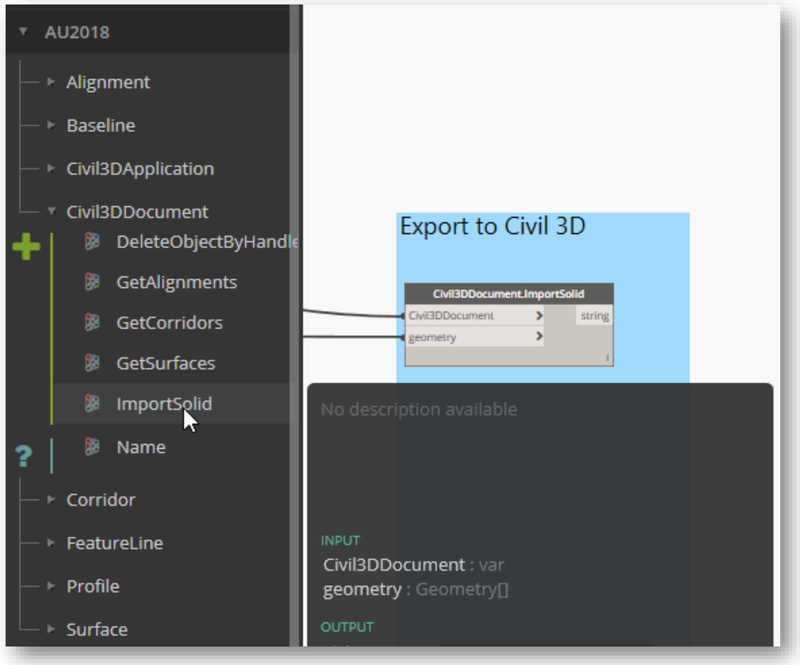


Creating Objects from Baseline and Excel

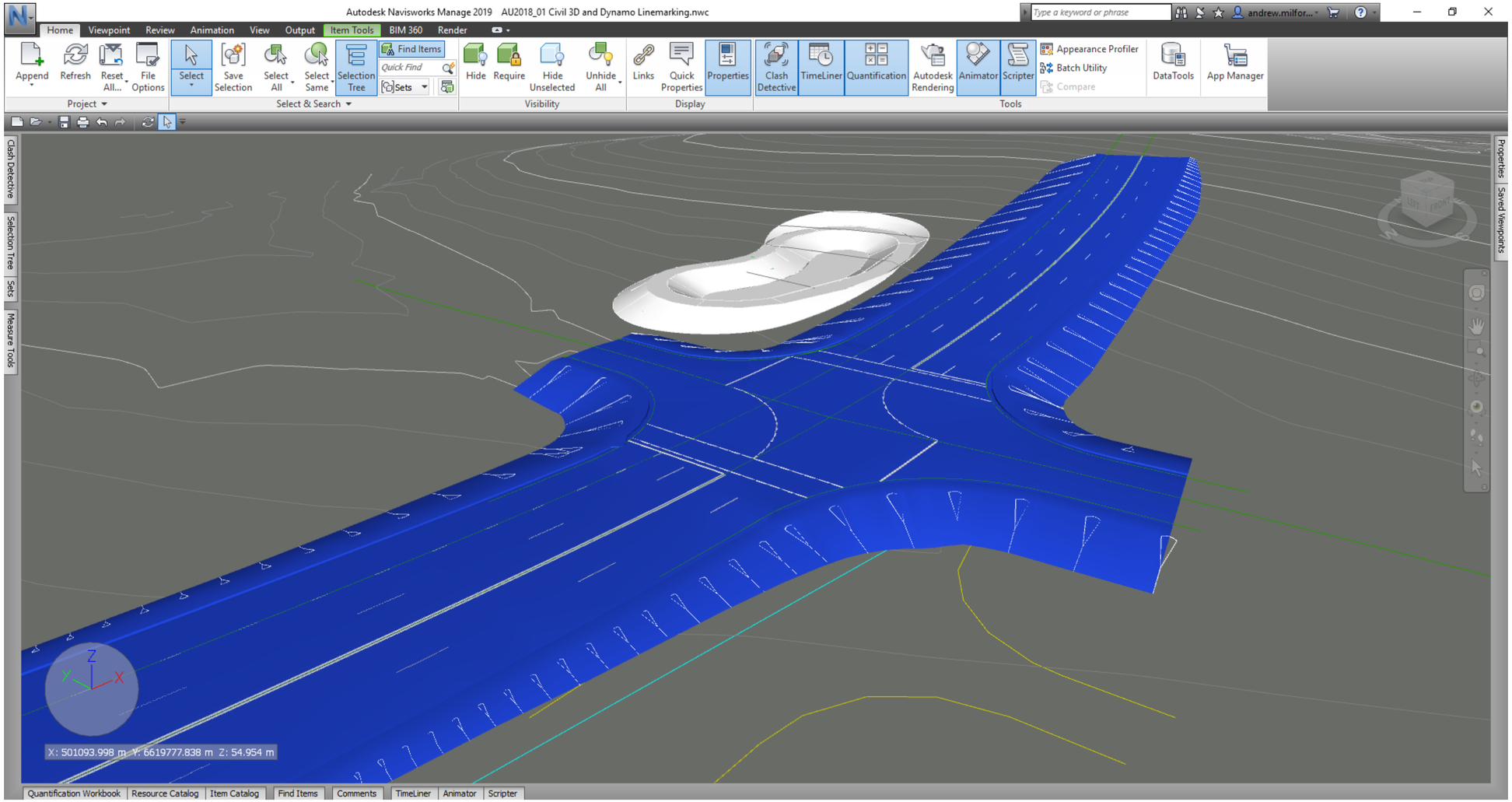
	A	B	C	D	E	F	G
1	Baseline	Name	Station	Offset	Elevation	Rotation	Handle
2	MC10	Light_Pole_14m	655	9	-0.175	180	
3	MC10	Light_Pole_14m	675	9	-0.175	180	
4	MC10	Light_Pole_14m	695	9	-0.175	180	
5	MK50	Light_Pole_14m	25	-1.8	-0.1	0	
6	MC10	TrafficSignal	616	-12.3	-0.175		



Linemarking



Navisworks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