Structures Construction Introduction to Civil 3D
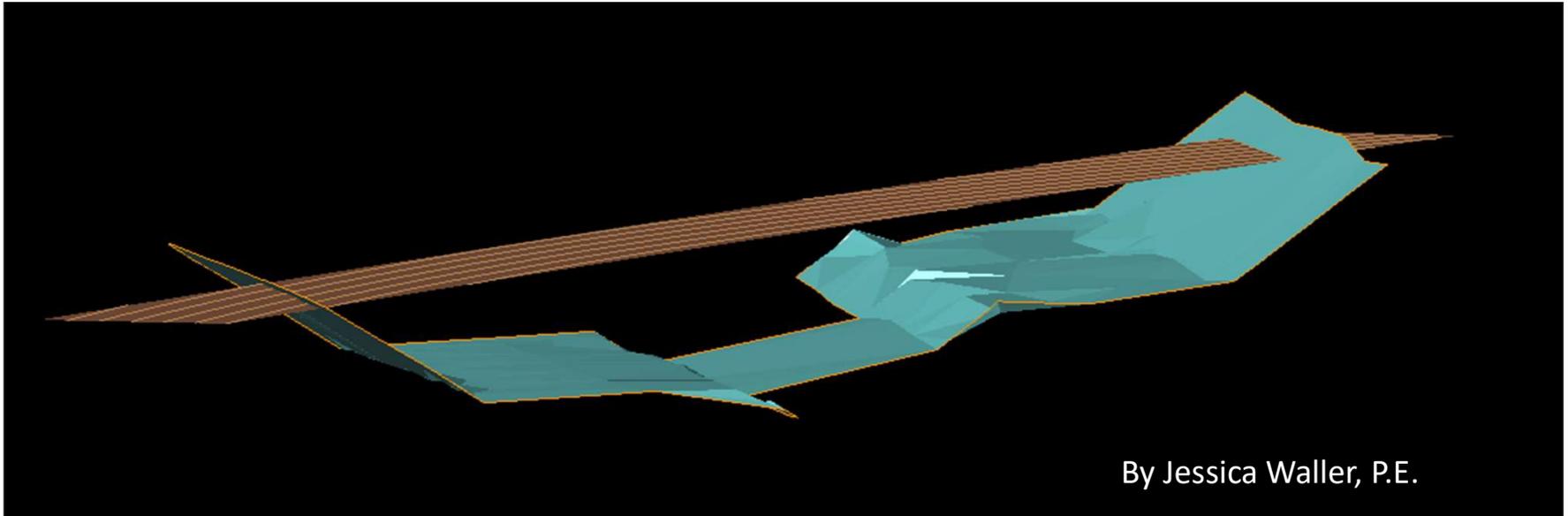
By Jessica Waller, P.E.

Outline

1. What's New in Structures Design
2. How Civil 3D can Make Structures Construction Work Easier
3. What is a TIN Surface
4. How does a TIN Surfaces Work
5. What Files You Need from Structures Design
6. How to Use Civil 3D for Structures Construction
7. Questions

What's New in Structure Design?

- MicroStation is Design's main drafting software to creating their plan sheets. A new version of MicroStation is coming by the end of 2020 (MicroStation Connect)

- The new MicroStation Connect does not have the ability to create Bridge Alignments and Deck Contours.

- This is forcing Structure Design to use Civil 3D by Autodesk to generate these bridge alignments and create deck surfaces for the deck contours on the project plans.

- Each Structures Design Branch has recently trained one of it's engineers to use Civil 3D and create deck surface data files

Why do I care?

- Civil 3D is a tool that can make your work in Structure Construction **EASIER** and **FASTER**, similar to how a calculator is a tool that makes crunching numbers easier.

- Using Civil 3D, with a surface file, gives you an **electronic** "**4-Scale**". It allows you to generate more accurate results and in a fraction of the time.

- Structure Design has done the heavy lifting, they've already create the alignments and surface data files.

- In Structure Construction, you only need to know how to read the files and understand what the information is saying.

How Civil 3D Makes SC Work Easier

- You can get any **station location** and **offset** anywhere along the bridge alignment

- You can get the **slope** or **elevation** of any point on the surface drawing

- You can **export** 100s of elevation points to Excel

Given bridge alignment and station

Created Offset

"Route 12" Alignment

8

9.75' Rt "Route 12" 17+96.50

€ Abut 1
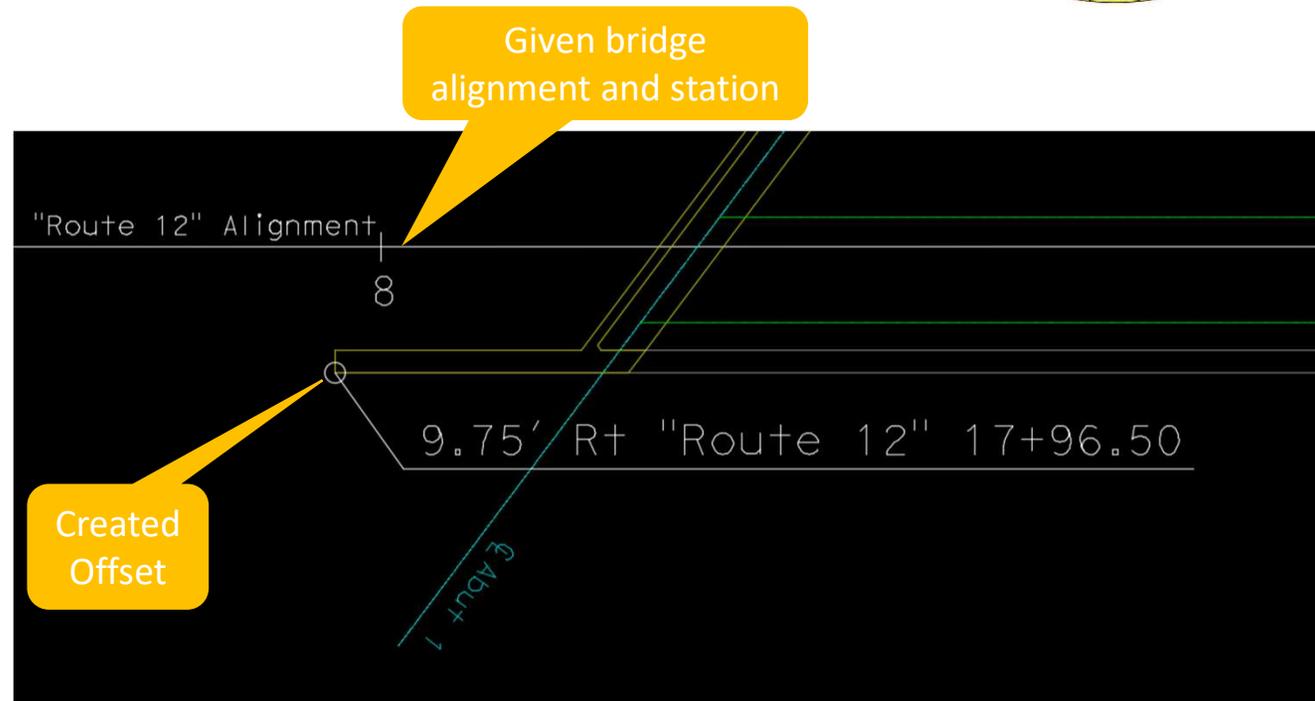
How Civil 3D Makes SC Work Easier

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Typical point layout example
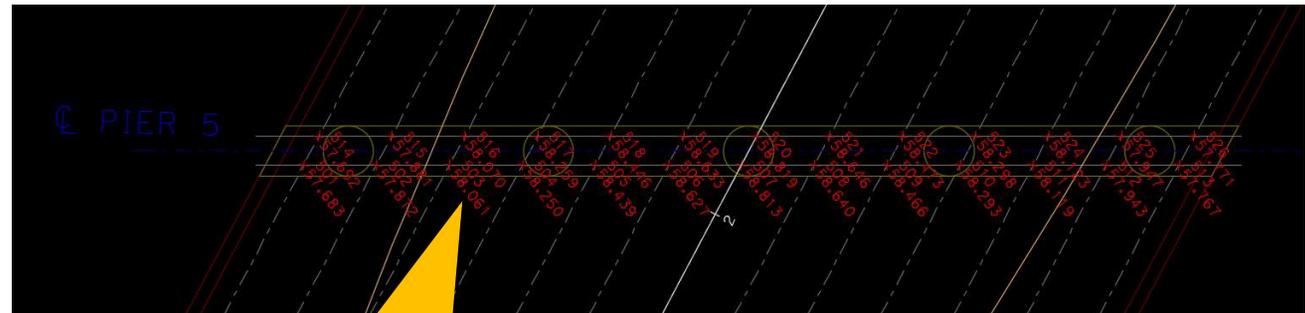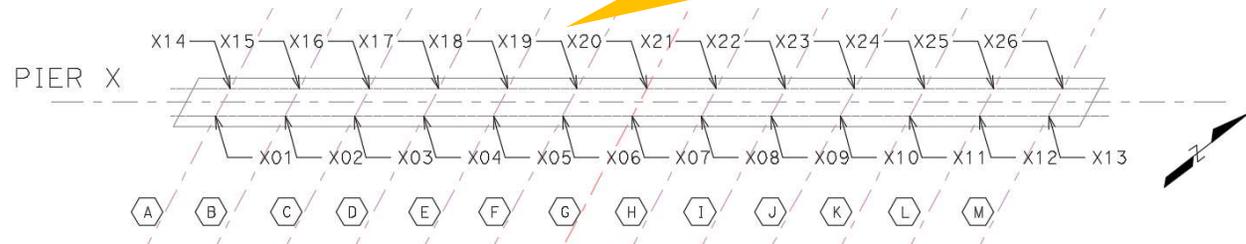
Created Points # and Deck Elevations

How Civil 3D Makes SC Work Easier

- You can get any station location and offset anywhere along the bridge alignment
- You can get the slope or elevation of any point on the surface drawing
- You can **export** 100s of elevation points to Excel

Exported Point # & Deck Elevations from Civil 3D to an Excel spreadsheet

	PT # (LEOD)	Theo. Elevation (ft)	Br. Camber (ft)	Deck Elev. (ft)			PT # (L of B1 CL)	Theo. Elevation (ft)	Br. Camber (ft)	Deck Elev. (ft)
Abut 1	101	19.5831	0.016	**19.60**		Abut 1	201	19.8335	0.016	**19.85**
Span 1	102	19.5762	0.056	**19.63**		Span 1	202	19.8214	0.056	**19.88**
@ 8.5'	103	19.5694	0.073	**19.64**		@ 8.5'	203	19.8142	0.073	**19.89**
	104	19.5694	0.056	**19.63**			204	19.7972	0.056	**19.85**
	105	19.5586	0.016	**19.57**			205	19.7806	0.016	**19.80**
Span 2	106	19.5466	0.012	**19.56**		Span 2	206	19.7794	0.012	**19.79**
	107	19.5372	0.047	**19.58**			207	19.7918	0.047	**19.84**
@ 9.75'	108	19.5481	0.062	**19.61**		@ 9.75'	208	19.8113	0.062	**19.87**
	109	19.5741	0.047	**19.62**			209	19.8364	0.047	**19.88**
	110	19.6018	0.012	**19.61**			210	19.8549	0.012	**19.87**
Span 3	111	19.6114	0.012	**19.62**		Span 3	211	19.8623	0.012	**19.87**
	112	19.6234	0.047	**19.67**			212	19.8802	0.047	**19.93**
@ 9.75'	113	19.6368	0.062	**19.70**		@ 9.75'	213	19.8904	0.062	**19.95**
	114	19.6506	0.047	**19.70**			214	19.9008	0.047	**19.95**
	115	19.6636	0.012	**19.68**			215	19.9203	0.012	**19.93**
Span 4	116	19.6756	0.012	**19.69**		Span 4	216	19.9323	0.012	**19.94**
	117	19.6817	0.047	**19.73**			217	19.9471	0.047	**19.99**
@ 9.75'	118	19.6913	0.062	**19.75**		@ 9.75'	218	19.9607	0.062	**20.02**
	119	19.7148	0.047	**19.76**			219	19.988	0.047	**20.04**
	120	19.7596	0.012	**19.77**			220	20.0064	0.012	**20.02**
Span 5	121	19.7692	0.012	**19.78**		Span 5	221	20.011	0.012	**20.02**
	122	19.7725	0.047	**19.82**			222	20.0119	0.047	**20.06**
@ 9.75'	123	19.7738	0.062	**19.84**		@ 9.75'	223	20.0324	0.062	**20.09**
	124	19.7987	0.047	**19.85**			224	20.0608	0.047	**20.11**
	125	19.8243	0.012	**19.84**			225	20.0812	0.012	**20.09**

Field Grades_8-20-20

7

How Civil 3D Makes SC Work Easier

There are step-by-step tutorials available for Structure Construction:

1. Create Deck Elevation Points

2. Falsework Grade Check and Camber Strips

3. Elevations for Lost Deck Dowels
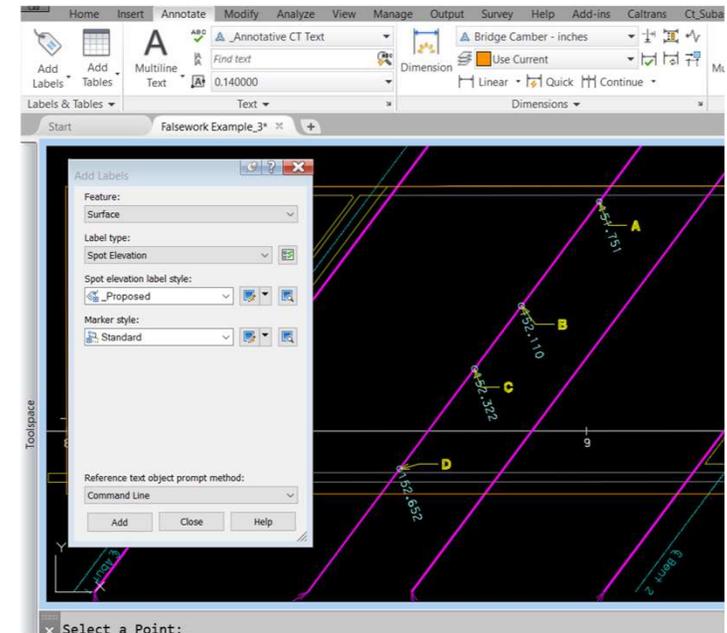
How Does a TIN Surfaces Work?
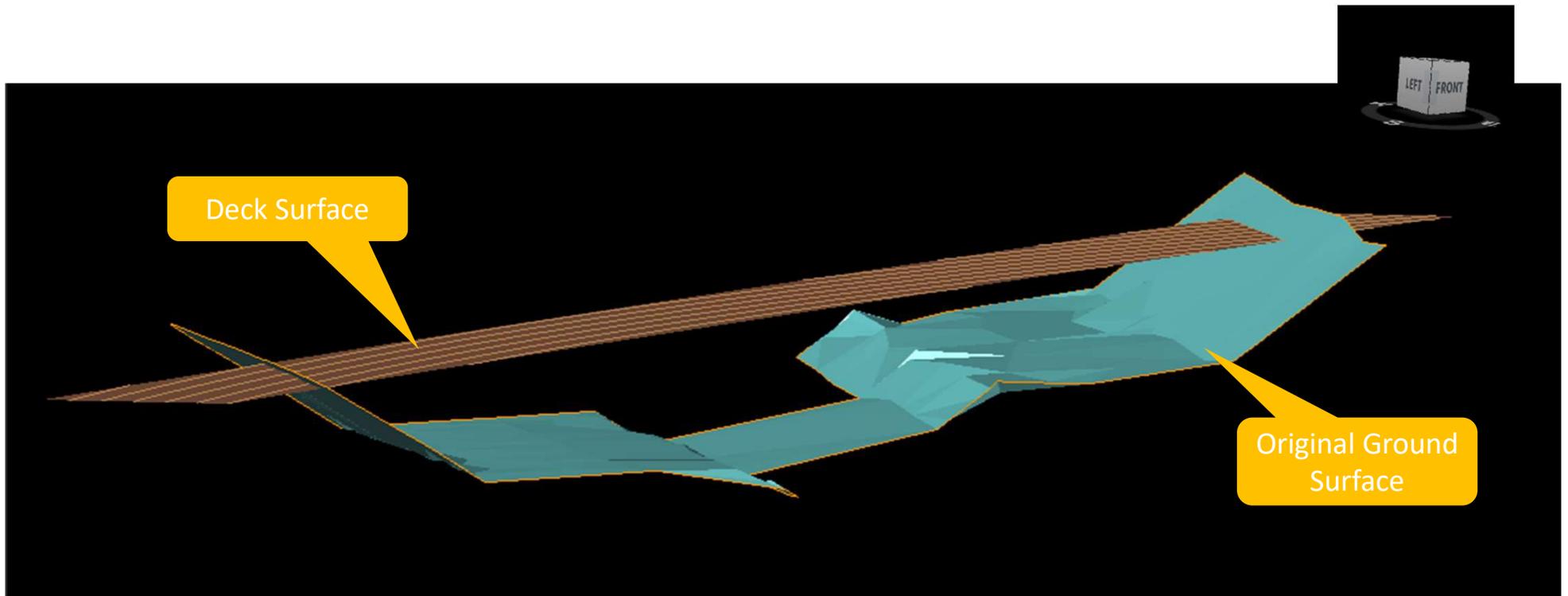
3D VIEW

# What is a TIN Surfaces?

- A **surface** drawing is a three-dimensional geometric representation of an area of land

- Surface drawings displaying <u>boundaries</u>, <u>contours</u>, and <u>elevation analysis</u>

- A surface is comprised of triangles called a **TIN**, **T**riangulation **I**rregular **N**etwork, which is created when Autodesk Civil 3D connects the points that make up the surface data.

How Does a TIN Surfaces Work?

- It starts with a group of **points** with given elevations.
- TIN lines form the triangles that make up the surface triangulation.
- To create TIN lines Civil 3D connects the surface points that are closest together.
- The elevation of any point in the surface is defined by interpolating the elevation of the vertices of the triangles that the points lies in.
- Contour lines connect these interpolated points.

Surface point with elevations

How Does a TIN Surfaces Work?

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- TIN lines form the triangles that make up the surface triangulation.
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- The elevation of any point in the surface is defined by **interpolating** the elevation of the vertices of the triangles that the points lies in.
- Contour lines connect these interpolated points.

i.e. Elevation is 125 between points 2 & 4

What Files You Need

Bridge Alignment with proper bearing, coordinates, and stationing
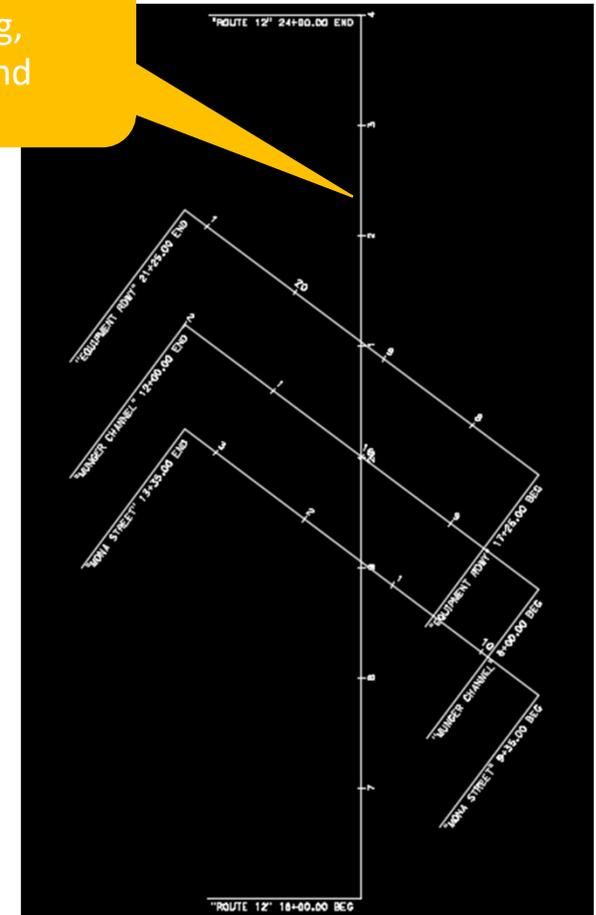
1. The Bridge Alignment .xml file

2. The Bridge Deck Surface .xml file

3. A .dwg file of the Bridge Layout linework in Real World Coordinates (including but limited to):

- Abutment layout
- Abutment centerlines
- Bent/Pier layout
- Bent/pier centerlines
- Column layout
- Girder centerlines

- Edge of Deck
- BB & EB
- Wingwalls
- Bearing locations

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Bridge deck surface, a TIN surface

What Files You Need

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Consult your Structure Designer for assistance in obtaining these files and help to combining them into a single .dwg file for use.
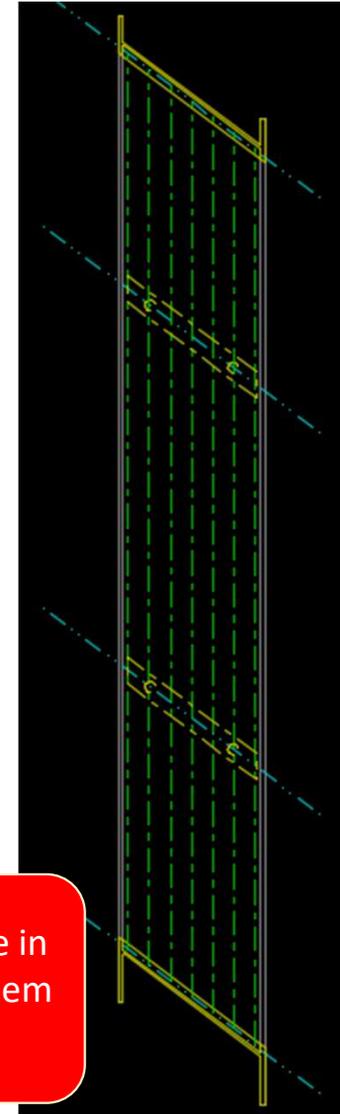
What Files You Need
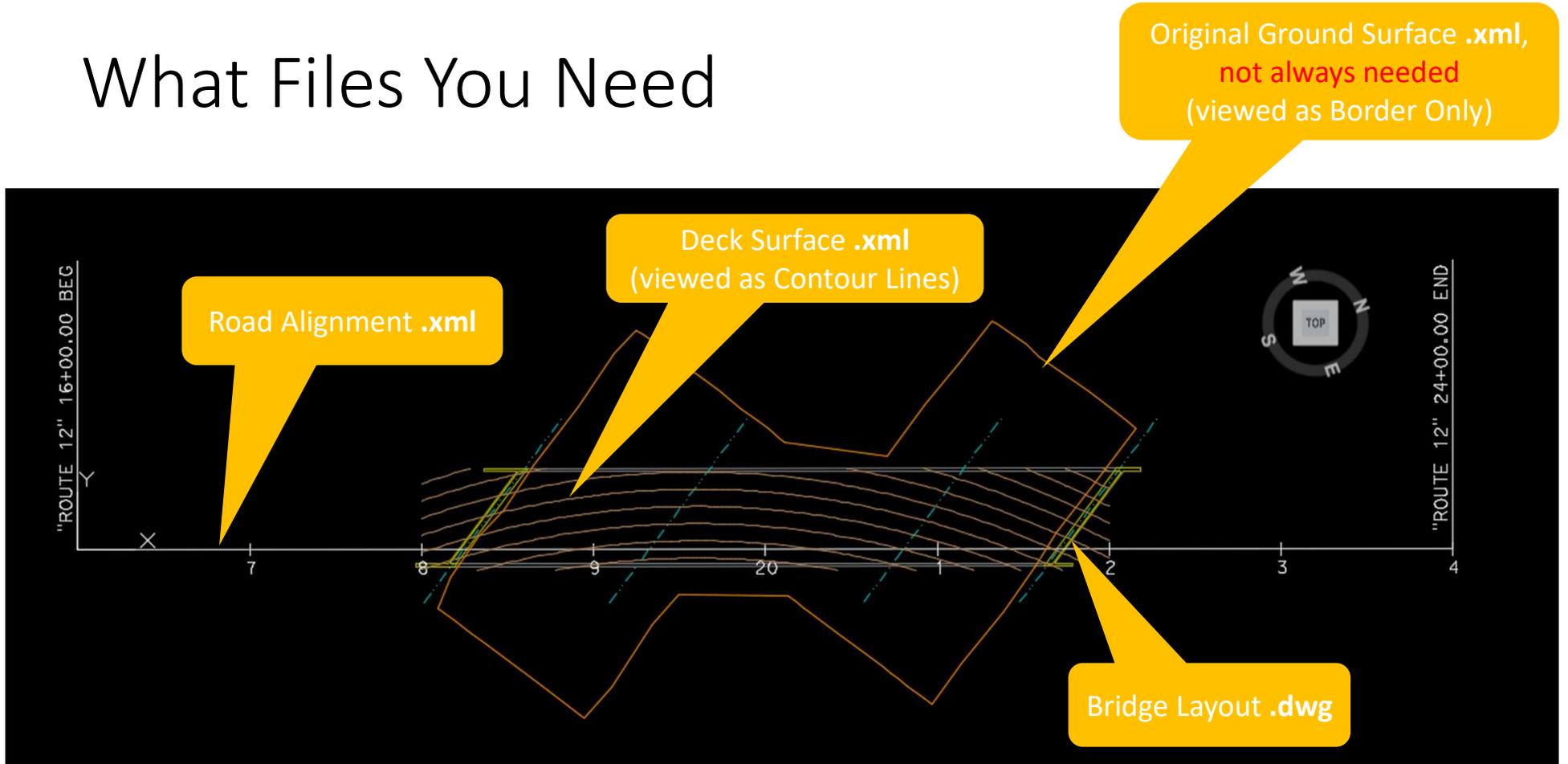
2D PLAN VIEW

STARTING UP CIVIL 3D

Yes, Civil 3D will need an update or it will CRASH and it will require fixing!

1. Double click on **Ct Civil3D Launcher** on your desktop

If Civil 3D doesn't work, run the Utilities Tools!
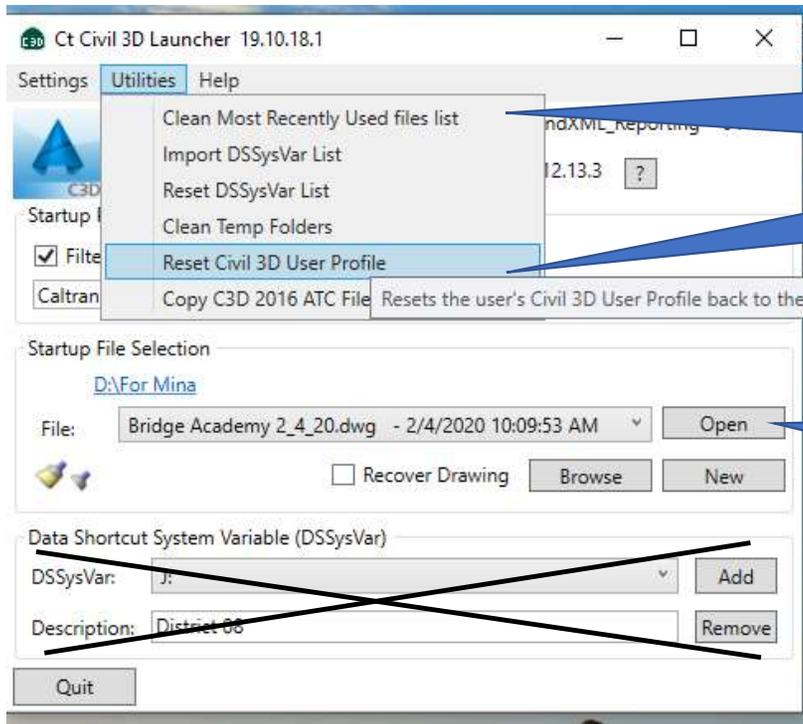
2. Typically run all the Utilities option to clean up Civil 3D and create a new drawing.

3. Save your drawing to the local drive and Open drawing for the first time through Ct Civil 3D Launcher.

SET DATUM & ZONE

2. Use Horizontal Datum to "**CCS 83**"

3. Set Vertical Datum to "**NAVD 88**"

5. Click **SET ZONE**

4. Click on the Zone Map to set Seed File

If the **.dwg** files is not set up already, start a new file and then import the **.xml** files

Missing Coordinate Zone

? Do you want to setup Coordinate Zone Settings for the Current Drawing?

Yes   No
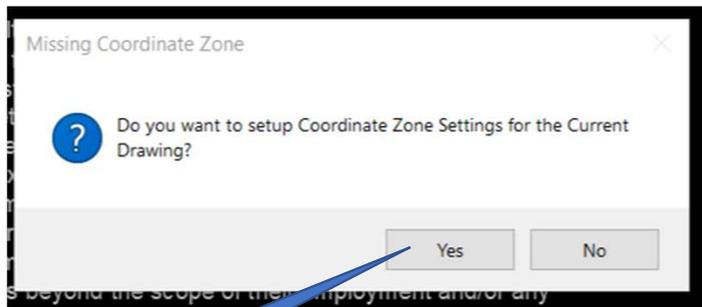
1. Click Yes

Use "SAVE AS", rename file and save to your <u>local drive</u>.

District	Seed File
1,2	Zone 1
1,3,4	Zone 2
4,6,9,10	Zone 3
5,6,9	Zone 4
5,7,8	Zone 5
8,11, 12	Zone 6

MOUSE & KEYBOARD CONTROLS

The most efficient way to use AutoCAD is to have one hand on your **mouse** and one hand on the **keyboard**.

MIDDLE mouse button controls the view.
Scroll to Zoom IN or OUT.
Hold down middle button to PAN

RIGHT click is used for Menu Shortcut

Hit **ESC** to break a command

LEFT click is for Selecting

5064 × 3093

COMMAND BAR

- The Command Bar is where you enter in the commands and find instructions for the next step
- Use your keyboard to enter in the short commands.

Command Bar

Follow the instruction for next step
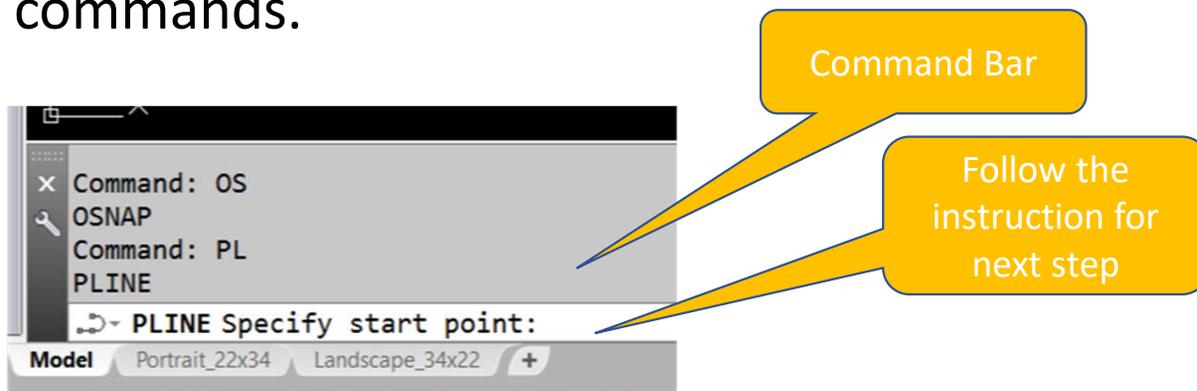
- L – Line
- PL – Polyline (PLINE)
- M - Move
- CO – Copy
- O – Offset
- RE – Regen
- E - Erase
- TR – Trim
- EX – Extend
- Z – Zoom
- U – Undo
- OS – OSNAP
  - NEA – Near
  - Per - perpendicular

21

MAIN TABS FOR SC

- **HOME**
- **INSERT**
- **ANNOTATE**
- ~~MODIFY~~
- ~~ANALYZE~~
- VIEW (not really needed for SC purposes but, worth exploring)
- ~~MANAGE~~
- OUTPUT (not needed, the output tab automatically appears when exporting points)
- ETC... (not needed)

The main TAB needed to read the given Civil 3D files for SC.
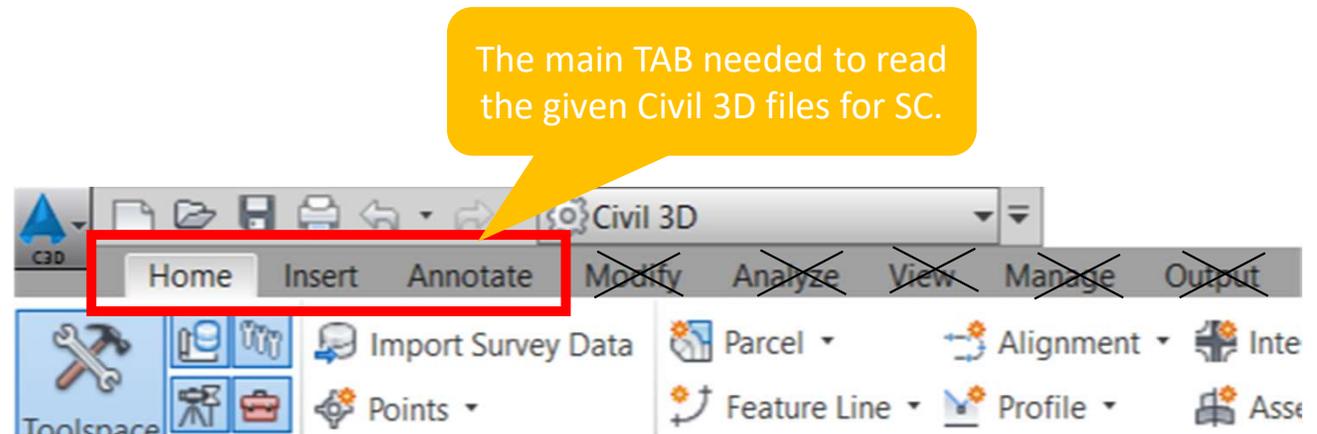
SURFACE PROPERTIES

- **HOME**
  - Palettes

Prospector needs to be turned **ON**

Click **TOOLSPACE** to view. The toolspace will be docked on your left side screen

PROSPECTOR:
This is where your **Surface** and **Alignment** files are stored and can make changes.

You only use this to change how you VIEW the surface data, such as the **Surface Properties** and **Surface Styles** (i.e. TIN, boarder, contours..)

Right click to get Surface Properties

Active Drawing View

- **Design Example**
  - Points
  - Point Groups
  - Point Clouds
  - Surfaces
    - Deck Surface Surface 1
    - Original Ground
  - Alignments
  - Feature Lines
  - Sites
  - Catchments
  - Pipe Networks
  - Pressure Networks
  - Corridors
  - Assemblies
  - Inter...
  - ...w Frame Groups
  - ...ta Shortcuts []
    - Surfaces
    - Alignments
    - Pipe Networks
    - Pressure Networks
    - View Frame Groups

Surface Properties...
Edit Surface Style...
Rebuild
Rebuild - Automatic
Create Snapshot
Remove Snapshot
Rebuild Snapshot
Add Label...
Delete...
Select
Zoom to
Pan to
Lock
Unlock
Export to DEM...
Export LandXML...
Refresh

23

POINTS TO EXPORT

- **HOME**
  - Palettes
  - Create Ground Data
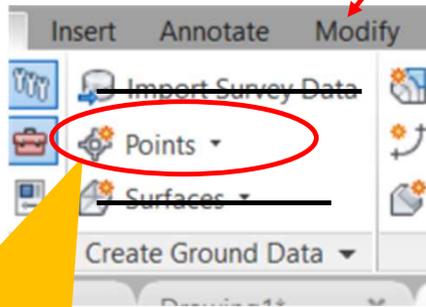
POINTS:
This is where you can create a labeled point on the deck surface and then export the point to Excel. See "How to Create Deck Elevations".

1. Click **Points**
2. Click **Create Point - Surface**
3. Click **Random Points**
4. Select the deck surface
5. Then click any where on the surface
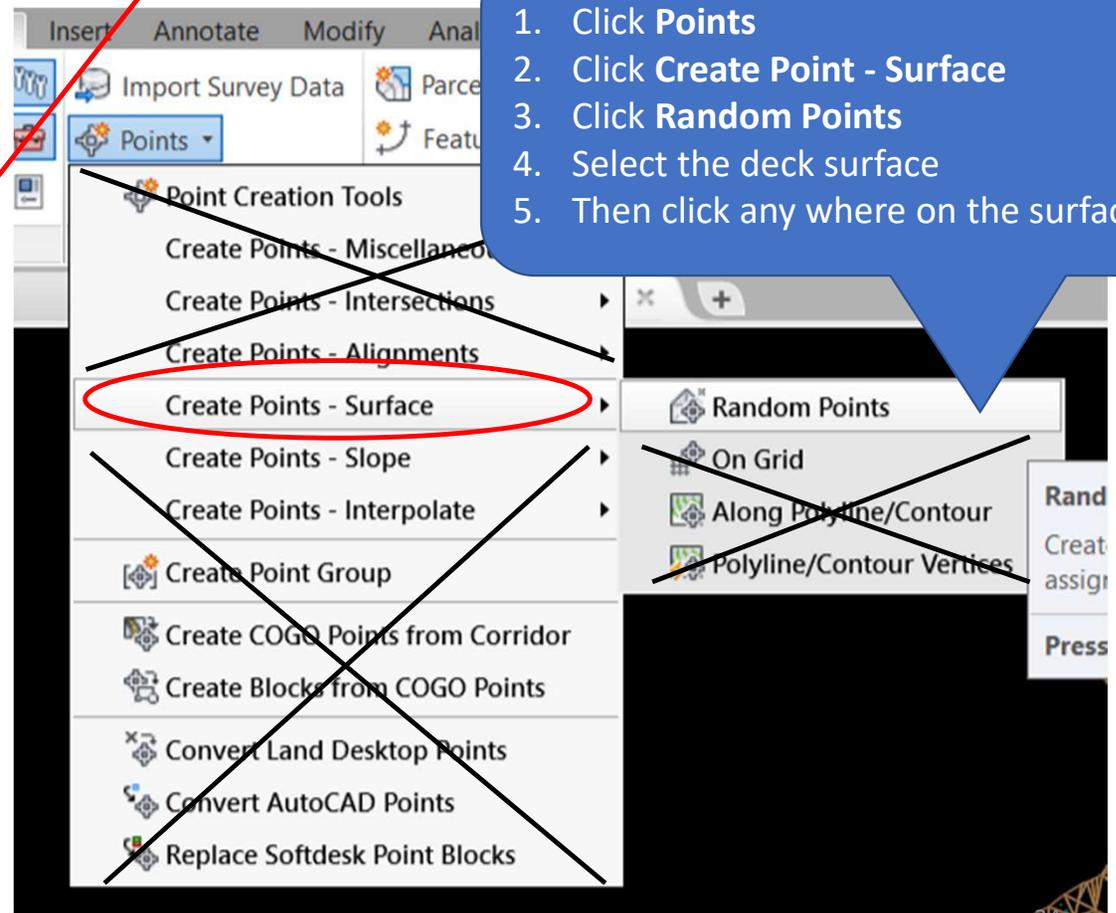
PROFILE & SECTIONS
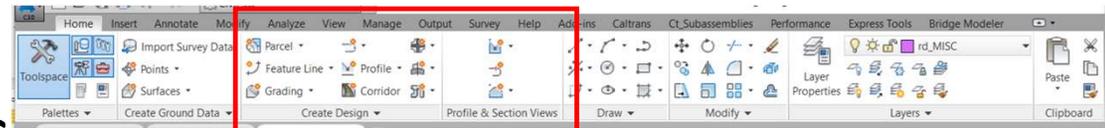
- **HOME**
  - Palettes
  - Create Ground Data
  - ~~Create Design~~
  - Profile & Section Views
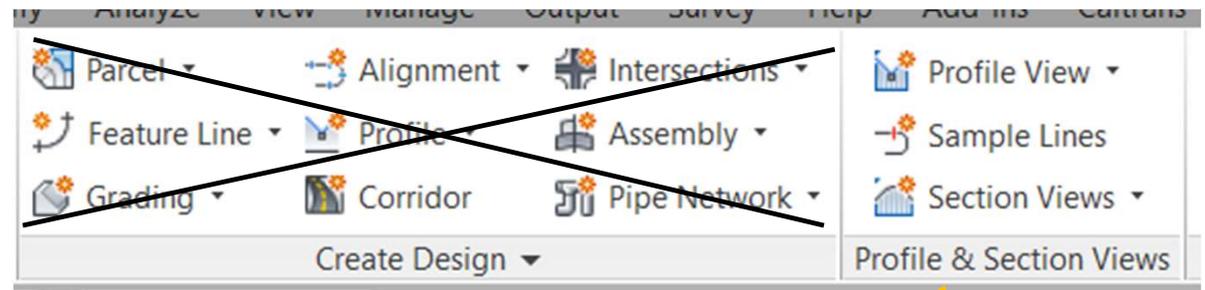
PROFILE & SECTION VIEW:
Here is where you can generate a profile or section view of your bridge. This is not covered in the tutorials at this time but, they are worth exploring.

DRAW & MODIFY

- **HOME**
  - Palettes
  - Create Ground Data
  - ~~Create Design~~
  - Profile & Section View
  - Draw
  - Modify

Line

Polyline

Offset

DRAW:
This is your draw palettes. Most MicroStation users prefer to use this in lieu of using the keyboard to typing in the commands

MODIFY:
Similar to the draw palettes.

LAYERS

• **HOME**

• Palettes
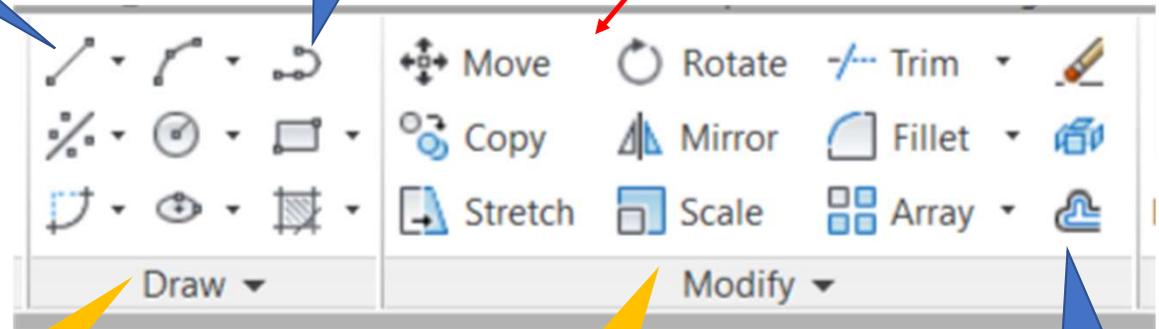
• Layers

Click to bring up the LAYER MANAGER

Each object has a base LAYER on which the object physically resides. You can control the display of these layers and create new layers as needed.

Click to switch between the layers
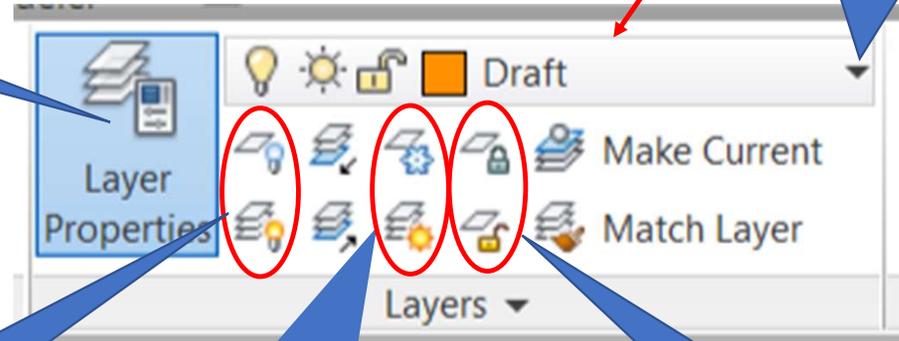
Draft

Layer Properties

Make Current

Match Layer

Layers

Layer ON and OFF. Allows you to reduce the line clutter

If you FREEZE a layer instead of turning it OFF, you'll see a boost in performance of the program

Layer LOCK and UNLOCK. Keeps you from deleting a line on accident

27
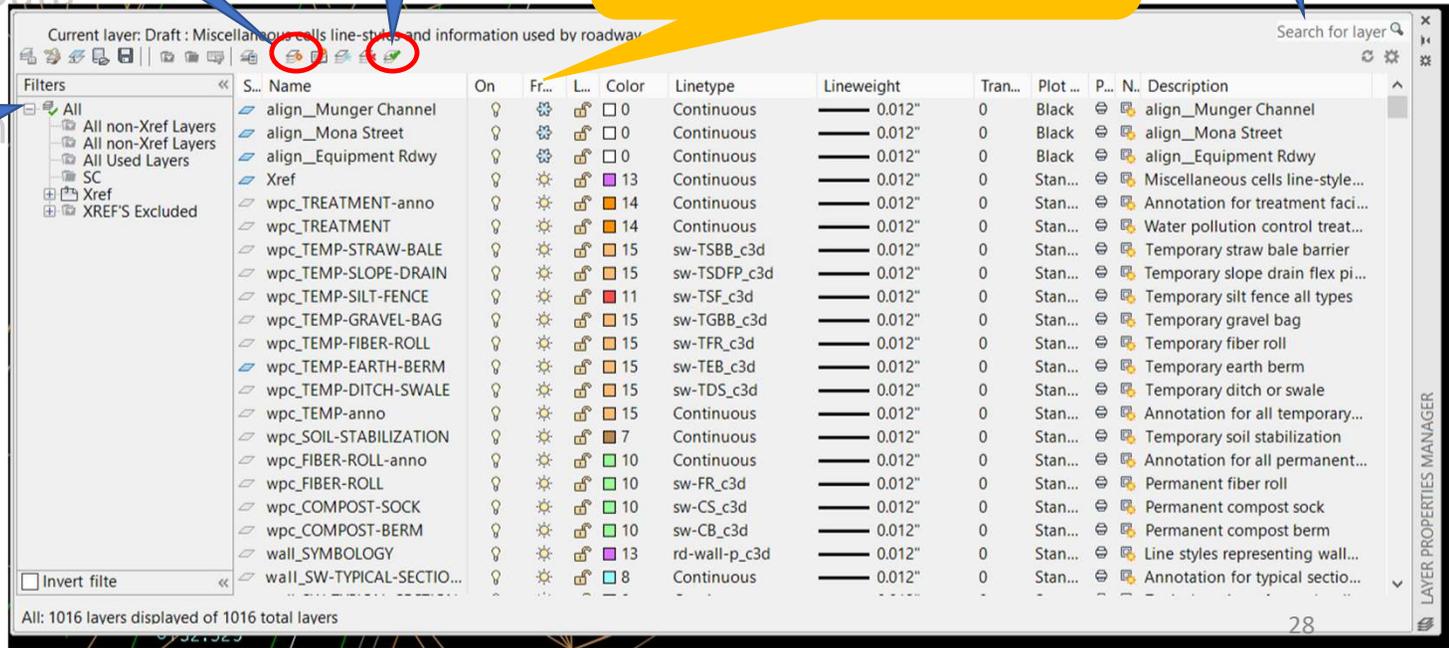
IMPORT

- **INSERT**
  - Import
  - ~~InfraWorks 360~~
  - ~~Blocks~~
  - Etc… (not needed)
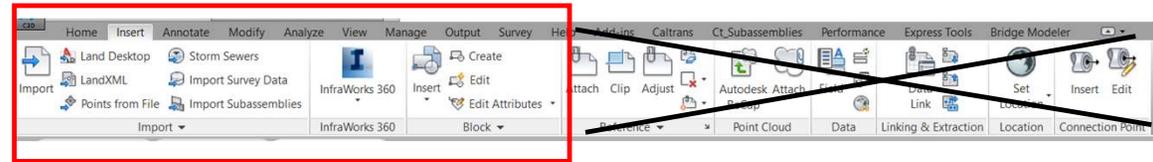
Click the **INSERT** tab
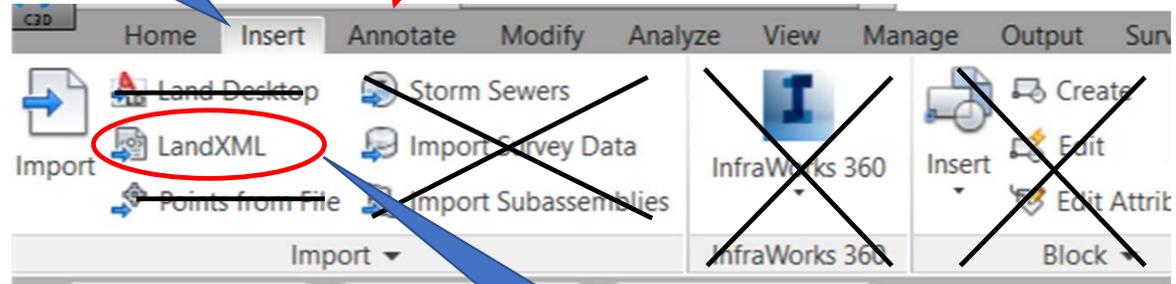
If your Structure Designer has not combined the bridge layout and **.xml** files for you. Save the **.xml** files to your locate drive.
Open the **.dwg** files in Civil 3D and then import the **.xml** files into your drawing yourself from here.

YES, It's that easy!

Click **LandXML** to import the project surface and alignment **.xml** files.

LABELS

- **ANNOTATE**
  - Label & Table

NOTE - Any point Northing & Eastings

LINE - Any Line bearing and lengths

ALIGNMENT - Any Station and offset distance

SURFACE - Any surface slope and elevations

Click the tag
ADD LABELS

1. Select the **FEATURE**,
2. Select the **LABEL TYPE**,
3. Click **ADD**,

Add Labels

Feature:
Alignment

Note
Line and Curve
Alignment
Parcel
Profile View
Section View
Surface
Pipe Network
Pressure Pipe Network
Intersection
Survey Figure
Catchment

Reference text object prompt method:
Command Line

Add   Close   Help

Home   Insert   Annotate

Add Labels   Add Tab   Multiline Text

0.1400

Labels & Tables

4. Follow the instruction on the command bar as needed.

Select a surface <or press enter key to select from list>:
Surface: Original Ground
ADDSURFACESLOPELABEL Create Slope Labels or [One-point Two-point] <One-point>:

Model   Portrait_22x34   Landscape_34x22   +   30   6.67
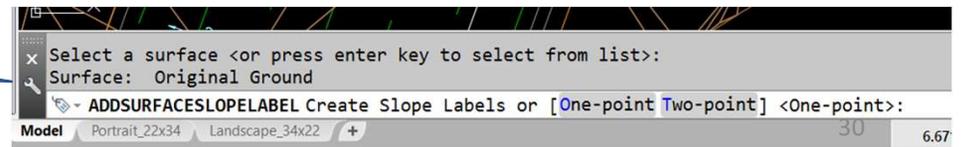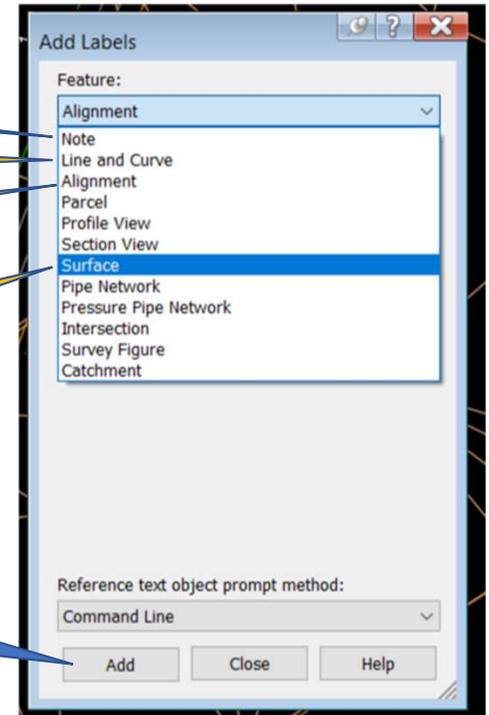
TEXT & DIMENSIONS

- **ANNOTATE**
  - Label & Table
  - Multiline Text
  - Dimensions

Click the **ANNOTATE** tab

Flip between the different Dimension Styles

Click to add Text

Click to add Dimension

LINEAR – labels the dimension horizontal or vertical distance.

ALINDNED – labels the true distance between two points

Create NEW Dimension Styles. Such as "Bridge Camber" for SC
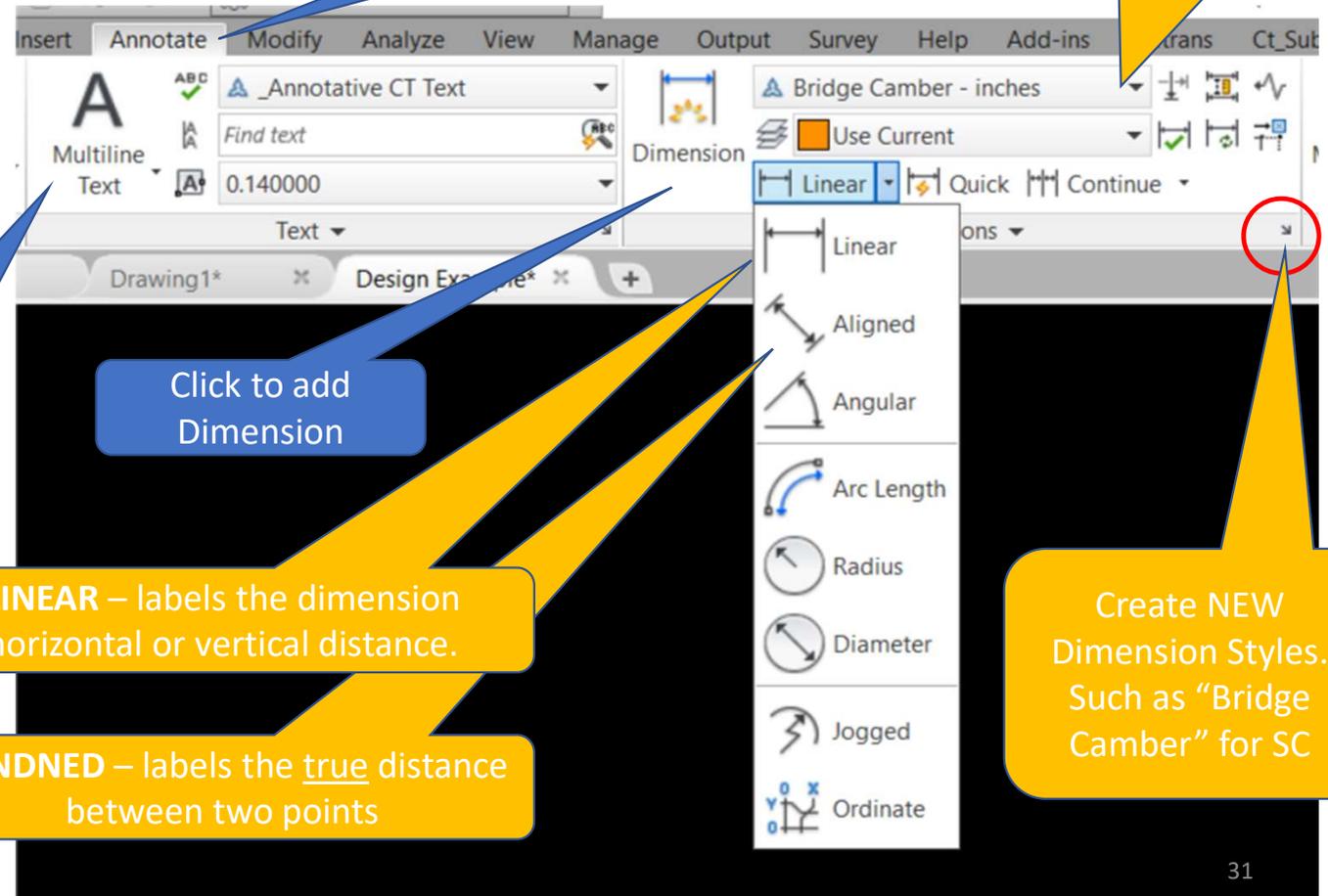
LEADERS

- **ANNOTATE**
  - Label & Table
  - Multiline Text
  - Dimensions
  - Leader
  - ~~Tables~~
  - ~~Markup~~
  - ~~Annotation Scaling~~

Click the **ANNOTATE** tab
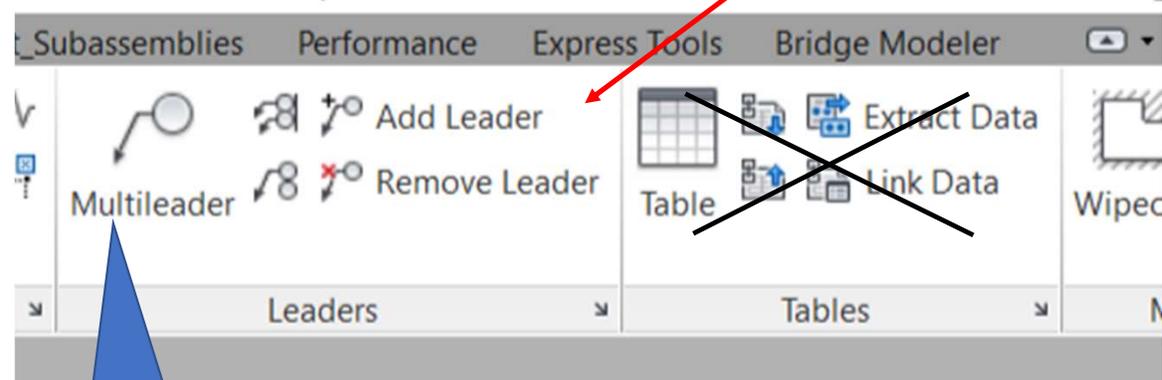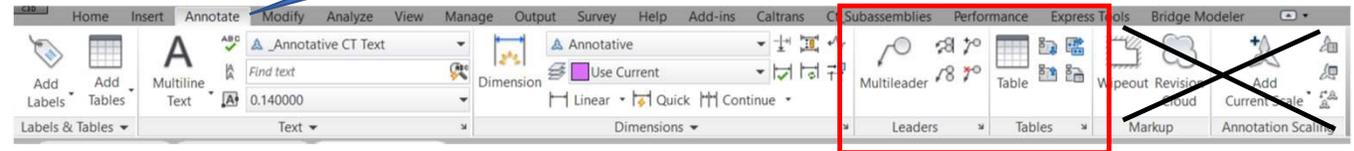
Click to add text with leader line and arrow

MODEL vs PAPER SPACE

- There are two distinct working environments, "**Model Space**" and "**Paper Space**"

- **Model Space** is drawn at 1:1 scale. In general, Model Space consists of a single view that fills the screen. Your bridge will be set in Real World Coordinates, meaning it will have an accurate bearing and ordination.

- **Paper Space** represents a paper layout of your drawing. Its easier to reorient the bridge layout horizontally when drawing camber.

- The **Viewport** is a window into Model Space.

Double click on the **VIEWPORT** (purple box) to work in Model Space with Paper Space orientation

```
Command: *Cancel*
Command:    <Switching to: Landscape_34x22>
Regenerating layout.
Regenerating model.
>_ ▾ Type a command
```

Paper Space

Model Space

Model   Portrait_22x34   **Landscape_34x22**   +

33
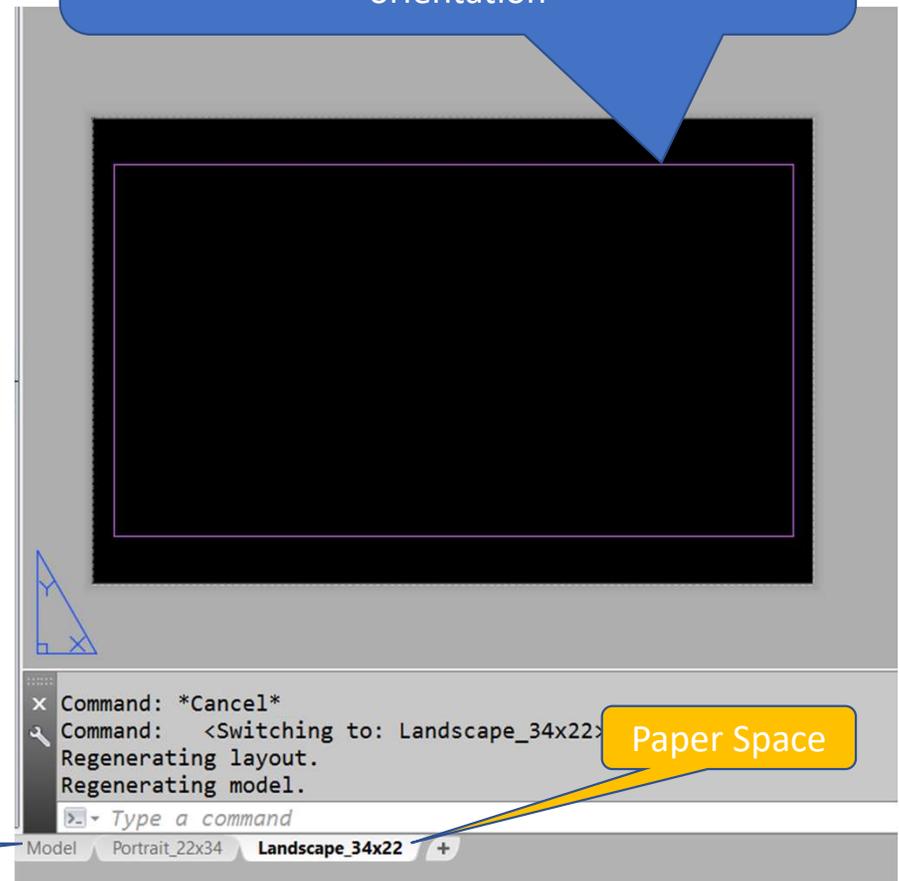
OSNAP & SCALE

- Object Snap (**OSNAP**), allows you to snap to specific points on an object.

- A green shape (i.e. triangle, square, angle…) will appear on the object if the OSANP is turned ON and only if certain snap settings are checked.

NOTE:
Your annotation will disappear (i.e. dimensions or text) if you draw in one scale and switch to a new scale

✓	Endpoint
✓	Midpoint
✓	Center
	Geometric Center
	Node
	Quadrant
✓	Intersection
	Extension
	Insertion
	Perpendicular
	Tangent
	Nearest
	Apparent Intersection
	Parallel

Object Snap Settings...

Scale to fit
1" = 1'
1" = 5'
✓ 1" = 10'
1" = 20'
1" = 30'
1" = 40'
1" = 50'
1" = 100'
1" = 200'
1" = 300'
1" = 400'
1" = 500'
1" = 600'
1" = 1000'
1" = 2000'
Custom...

6.671773E+06, 2.037209E+06, 0.000000   1" = 10'
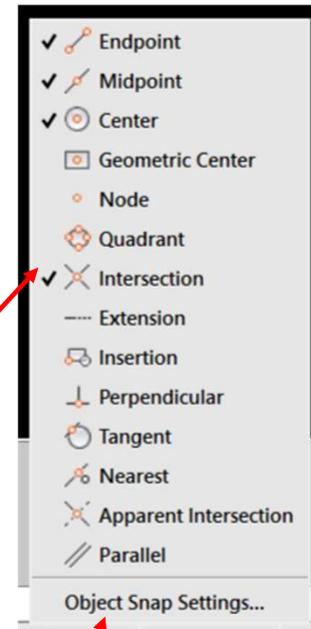
Drawing Coordinates of your cursor

Orthomode

OSNAP

Annotation Scale

34
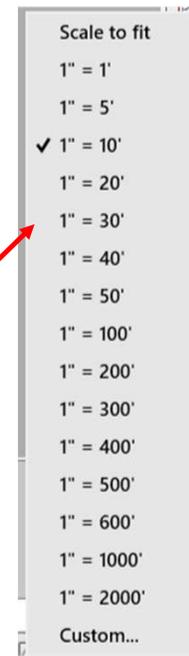
Civil 3D Help Resources

- Google – (i.e. "civil 3d How to….)
  - A lot of simple issues can be solved with a quick google search. There are several forms online, lots of people run into the same issue with Civil 3D.
- Statewide CADD Training Resources: MicroStation and Civil 3D
- For specific help regarding creation of Deck Contours and related training email: Bridge.Design.Civil3DHelp@dot.ca.gov
- For all other Civil3D related inquiries or help email: cadd.design.support@dot.ca.gov

Questions