CES323508

Advanced Grading & Earthwork Analysis in Civil 3D

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Learning Objectives

- Learn how to create a mass grading model
- Learn how to perform earthwork analysis and exhibit creation
- Learn about best practices for machine control models
- Learn how to manage large earthwork models in Civil 3D

Description

Mass grading requires detailed models, balanced sites, and forward-thinking engineers and contractors. This session will look at a couple of mass grading sites and some best practices in creating, editing, and managing your models. From our model, we'll extract actionable data for projects at the bid and construction stages. We'll also look at best practices for machine control models and discuss some pitfalls to avoid.

Speaker

As an accomplished consultant for over 15+ years, Shawn Herring is a well-known figure in the civil infrastructure design community. Shawn has many titles, Consulting & Services Manager for ProSoft, Owner of Region Engineering & Surveying and Co-Founder of RealityOne which specializes in LiDar and drone reality capture.

Over the past decade, Shawn has been involved in hundreds of projects across the country. During his vast career, Shawn has trained thousands of CADD users, helped hundreds of civil infrastructure companies and major Department of Transportations implement new technologies, standardize workflows and enhance productivity. Shawn has been a part of 100's of Drone and LiDar scanning projects, ranging from simple roadway scans to complex contaminated land restoration projects consisting of 100's of acres.

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Class Overview

This is a 60-minute class, meaning there is no way to cover all data in detail within the 60 minutes provided. The intention is to look at several ways to quickly increase productivity and decision making on land development sites and to become familiar with the options we have for quantifying and displaying our earthwork quantities.

In this session, we will look at the following:

- Subassembly Composer
- Project Setup
- Data Shortcuts
- Corridor Modeling
- Grading Features
- Volume Takeoff and Exhibit Creation
- Machine Control Guidance

Project Overview

For the main exercise, we will look at a large residential subdivision. This subdivision consist of approx.. 160 acres and 475 lots. This is on a very challenging site and several million total yards of material will be moved, and over a million yards exported.

The challenge we face on a lot of our projects is working with different clients and their different criteria on how they want their lots rough graded. Nobody wants to move dirt twice and nobody wants to import/export and the home building stage.

The roads themselves are pretty simple, follow engineering best practices and local municipal standards and the roads will come together. But the lots are a whole new challenge. Where some choose simply not to design the lots, in mass grading effort, we'd prefer to see the whole picture and leave the lots in a buildable stage by the time they are turned over to the vertical team. Sounds crazy right???? Below are the lot criteria decided upon for this project.

Client Lot Criteria

- ***LotCriteria_A*** - Uphill Side. Large cut. Drains from the rear of the lot to the street. The assembly will go 20' from back of curb, step up 3' and extend to back of lot
- ***LotCriteria_B*** – This is an area where the lot is relatively flat. The assembly will go back 10' @ 2%, with a cut depth of 1' @ 2:1 for basement spoils.
- ***LotCriteria_C*** – This is a basement lot, (4 in / 4 out). Lot cuts down for 3 feet at 2:1 slope, the has specified lot pad depth/slope
- ***LotCriteria_D*** – This is a walk out basement lot where the rear portion is 8 feet lower. Lot cuts down for 8 feet at 2:1 slope, the has specified lot pad depth/slope

Project Setup

Utilizing Data Shortcuts is the only way to keep these types of projects clean and organized, and works well in keeping constantly updated quantities and exhibits. There are many ways to properly break out your files (design and sheets), so this is just one example. For simplicity sake, and time sake, I have broken out my project files as noted below:

- ***Design Base 2D*** – Contains ONLY 2D geometry of my sites.
- ***Design Base*** – Contains all XREF and alignments
- ***Utility Base*** – Contains ONLY utilities. In this case, all utilities are in here, but in many cases, I break out additional DWGs for each utility (WAT, SEW, PI, SD, etc)
- ***Grading Base*** – Contains XREF of 2D, Datashortcut of EG, alignment/profiles and corridor. Datashortcut for FG and datum created
- ***Existing Base*** – Contains all survey data and EG surface. Datashortcut of EG created.

We will do all of our work in the grading base, but first we want to create the necessary subassemblies using subassembly composer.

So, let's get started!!

Subassembly Composer (SAC)

New to SAC? No problem! SAC is a simple interface used to develop subassemblies for use within AutoCAD Civil 3D without the need to learn programming. The user interface is basically drag and drop from a “Tool Box” into the “Flowchart” in order to define geometry.

You can add the basic building blocks of a subassembly; points, links, and shapes using SAC.

This can be a very simple process, or these can be extremely advanced, all depending on the needs of your project.

Use stock assemblies if possible, become familiar with the help documentation, and then resort to SAC.

There are several ways to create these SAC files, referred to as a PKT file. You could simply create one PKT for each criteria set, create a PKT with a Cut/Fill Decision or use the Switch options and create all criteria in one PKT file!!

I will review with the class each of the options, below is a step by step direction of creating a simple PKT file with a Switch routine.

- Separate Criteria (Lots)
- Cut/Fill Decision
- Switch

SAC Composer Exercise

For this document, I have chosen to break out this section separately, please see the following document for this exercise:

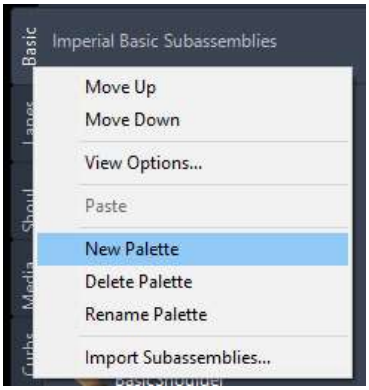
CES323508 - Advanced Grading & Earthwork Analysis in Civil 3D - SAC Supplemental Document

Civil 3D

Before we get started on the design, we need to quickly build our new tool palette.

Create New Tool Palette in Civil 3D

1. Open the Grading Base.dwg
2. Right click on any palette and select New Palette, name the palette LotGrading (or anything you want).

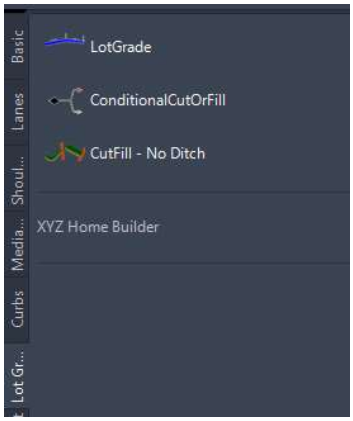


You can add existing subassemblies from other tabs, and also import the PKT files that were created in Subassembly Composer.

3. Go to the generic tab, select LotGrade, right click and COPY. Switch back to the LotGrading tab, right click and PASTE. Do the same for the ConditionalCutOrFill as well as the BasicSideSlopeCutDitch.

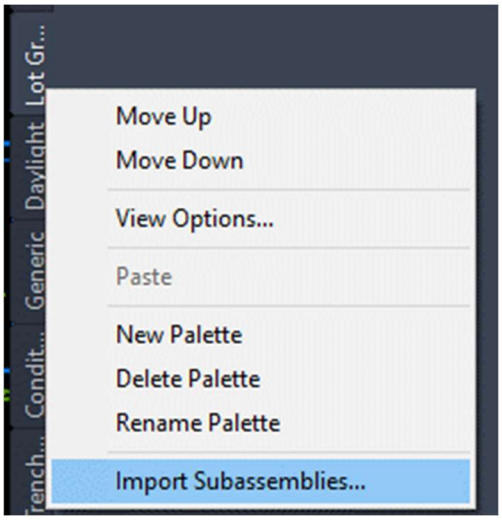
You can rename and change properties of any of the subassemblies!! You can also add text or a separator to better organize your custom palettes.

4. Add a separator, a text and a second separator as shown below.

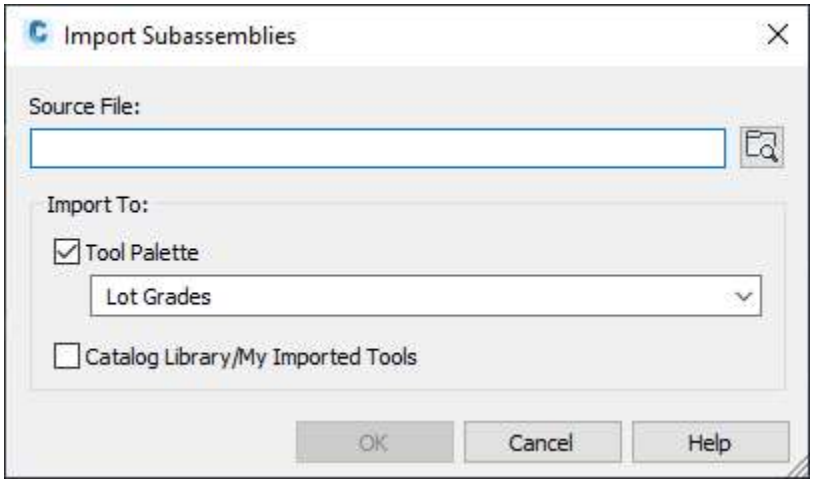


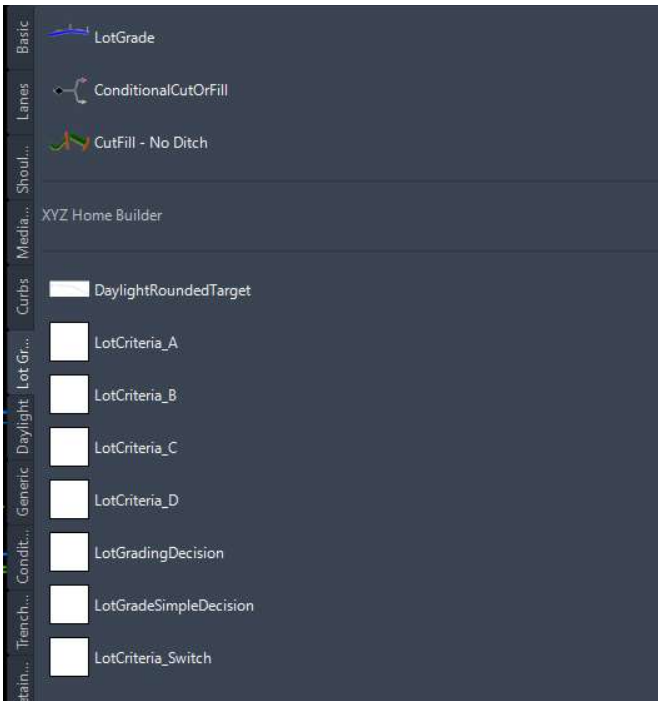
Import PKT files onto Palette

5. Right click on your Lot Grading palette and select Import Subassemblies…



6. Select your source file, or multiple files, and ensure your Lot grading Palette is the one it will import to.





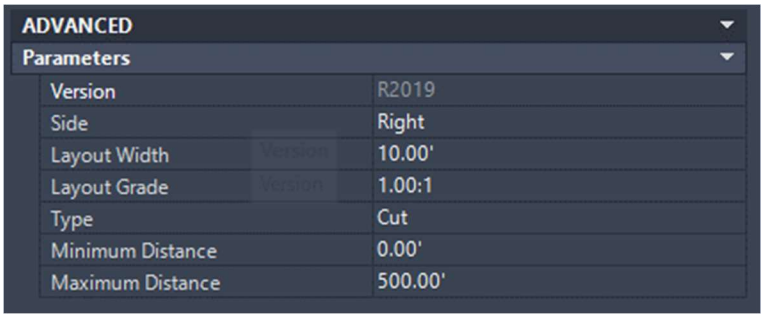
The project is all set up, alignments/profiles created, EG as a data shortcut and the corridor completed. We are just going to focus on adding the newly created assemblies and review the model.

Add SA PKT files to Existing Assemblies

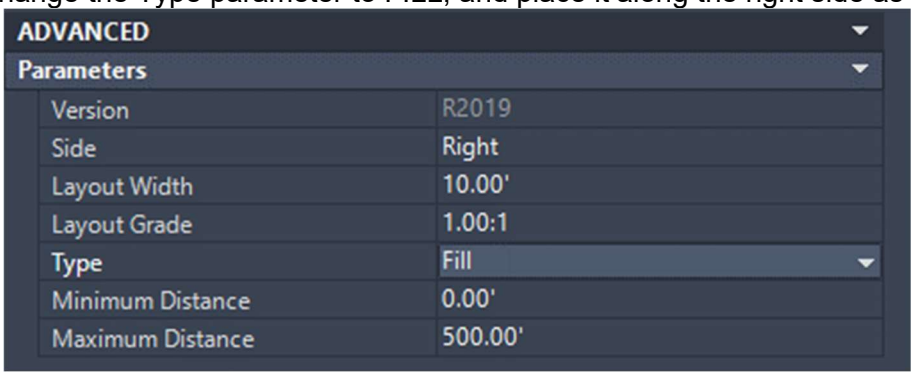
Let's explore a couple options for one of our roads. There are MANY ways to model this, and we will look at a couple different options.

I typically just run a full section (back of walk to back of walk) initially, without all the other stuff added, just until I'm comfortable with my vertical design. And depending on the project, I don't use daylight subassemblies, I just let roads tie to each other, or tie it down with feature lines if needed. Again, hundred of ways to design this stuff!

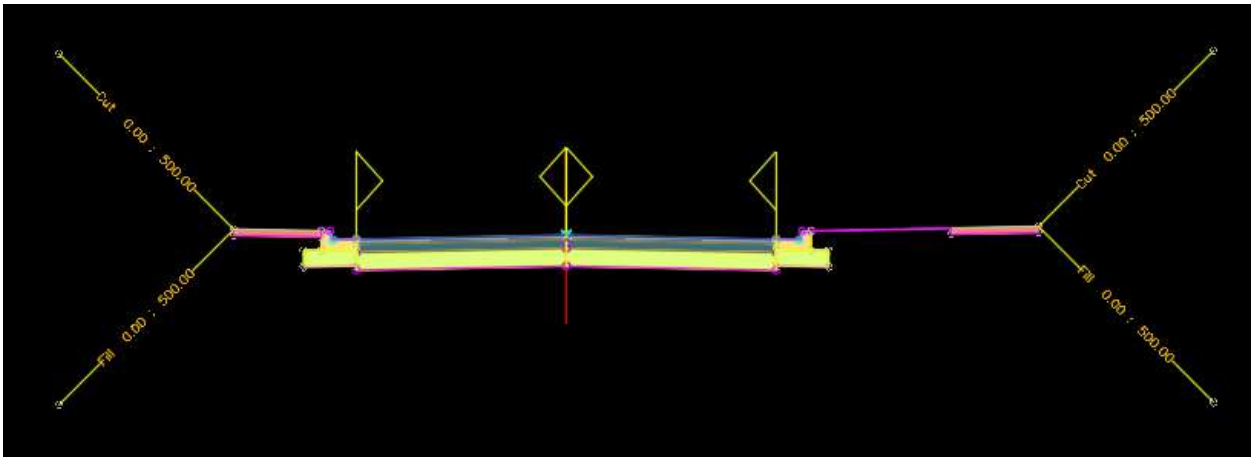
7. Copy down the Basic Assembly (Full Width) assembly, rename it Basic Assembly (Full Width w/ Condition).
8. Select the ConditionalCutorFill from the palette, and adjust the properties as shown. Place it on the right side of your Assembly.



9. Change the Type parameter to FILL, and place it along the right side as well.

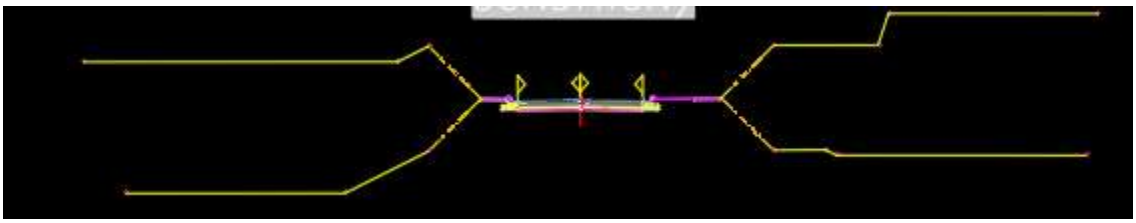


10. Now do the same for the left side. Your assembly should look like this.



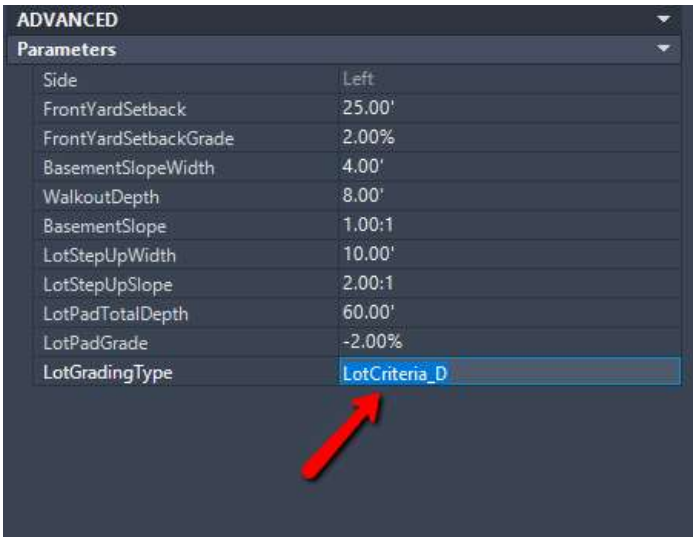
We can now place subassemblies on each side, and the assembly will decide what to do in cases of cut v/s fill. Pretty straight forward simple example on how to use the conditional Cut/Fill subassembly.

11. Use the following criteria to place the 4 subassemblies.
    a. Right Side Cut – LotCriteria_A
    b. Right Side Fill – LotCriteria_B
    c. Left Side Cut – LotCriteria_C
    d. Right Side Fill - LotCriteria_D
12. Your assembly now looks like this!



Now, if you don't want to use conditional subassemblies, you can make the decision for yourself on where to place which assembly. The switch subassembly we created could be very helpful in setting all your criteria, without having to need multiple subassemblies. Let's add that one to our file.

1. Copy down the Basic Assembly (Full Width) assembly, rename it Basic Assembly (Full Width w/ Switch).
2. Add the LotCriteria_Switch to both the left and the right side
3. The subassembly is shown with the default criteria that we created in SAC. However, select the left side switch assembly and view all the parameters you have to work with!! Simply change the LotGradingType to LotCriteria_D and see what happens!



For this session, we will keep it at that, but feel free to explore all your options.

NOTE: These are full width assemblies, you will want to create additional assemblies, Typically I have a list of assemblies similar to this:

- For Cul-De-Sac (Typically one sided)
- Curb Returns (Typically one sides, and sometimes just Curb, Gutter and Asphalt)
- Intersections
    - Copy your assembly and remove left side fully, right side fully, or just left/right curb, gutter and sidewalk)

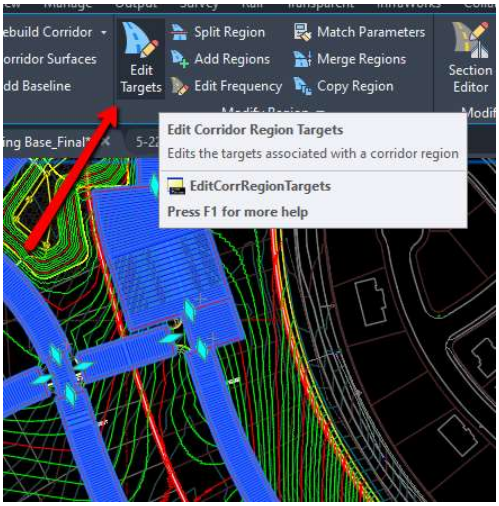
Our focus for this session will be Road A, all steps above and below can be considered the same for all roads.

Apply your new assemblies to Road A as shown below.

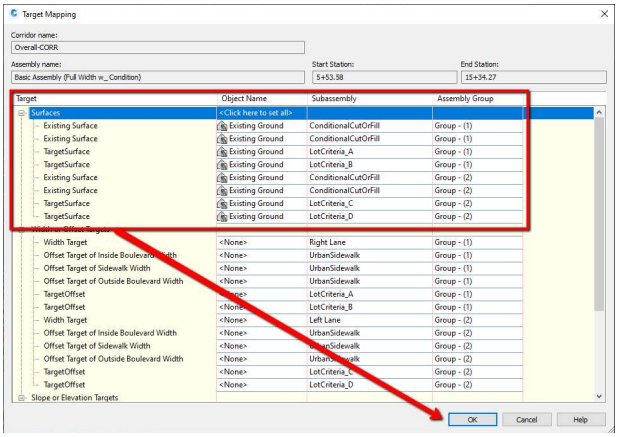
Basic Assembly (Full Width w/ Switch - NO RT)	0+50'	2+34.18'
Basic Assembly (Full Width w/ Switch)	2+34.18'	4+77.30'
Basic Assembly (Full Width w/ Switch - INT RT)	4+77.30'	5+53.58'
Basic Assembly (Full Width w/ Condition)	5+53.58'	15+34.27'
Basic Assembly (Full Width w/ Condition)	16+13.66'	27+28.28'
Major Residential - Sidewalk Right INT RT	27+28.28'	28+07.55'
Basic Assembly (Full Width w/ Switch)	28+07.55'	36+39.94'

Map Targets in Corridor

1. After you change your assemblies in the corridor properties, you have to properly set the targets. The conditional use assemblies require a surface to be set, so that it knows where cut v. fill is.
2. Select your corridor, from the Ribbon choose EDIT TARGETS



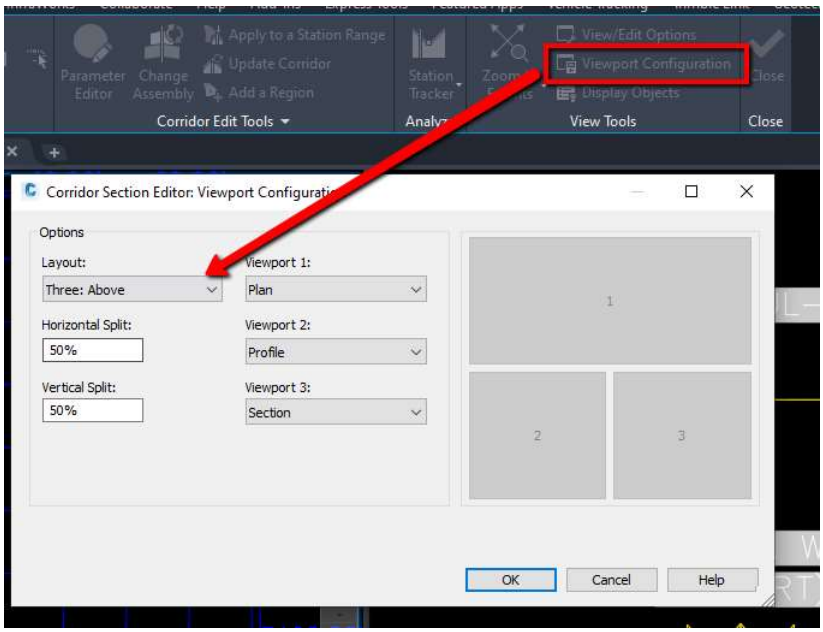
3. Select the region you want to adjust targets on (where not lot grading is shown), and the target mapping appears. In the surfaces Target options, select Click here to set all, and choose the Existing Ground surface, then select OK. (Do the same on other regions)



Section Editor

Use the section editor to explore the corridor! This works great for fine tuning your design and inspecting your model.

4. With your Corridor selected, choose Section Editor from the ribbon.
5. Select Viewport Configuration, and change the layout to Three: Above, then select OK

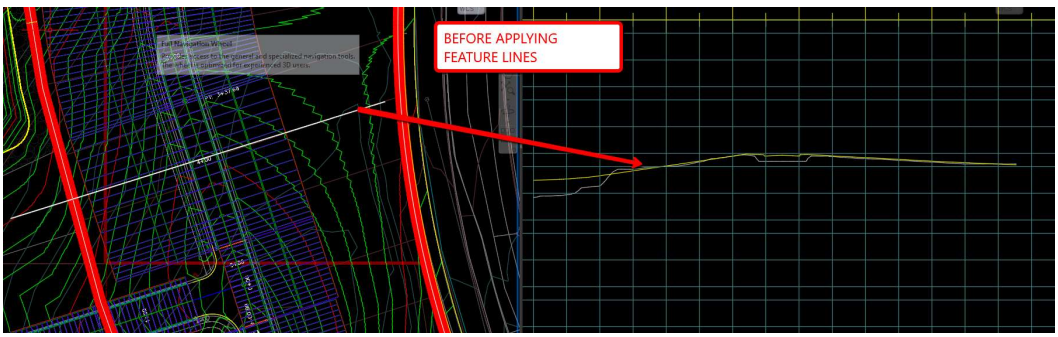


6. Make sure your baseline is set to Road A, and jump to somewhere around station 7+00. You can now see the decision-making process and how it works.
7. Close the section Editor, and save your drawing.

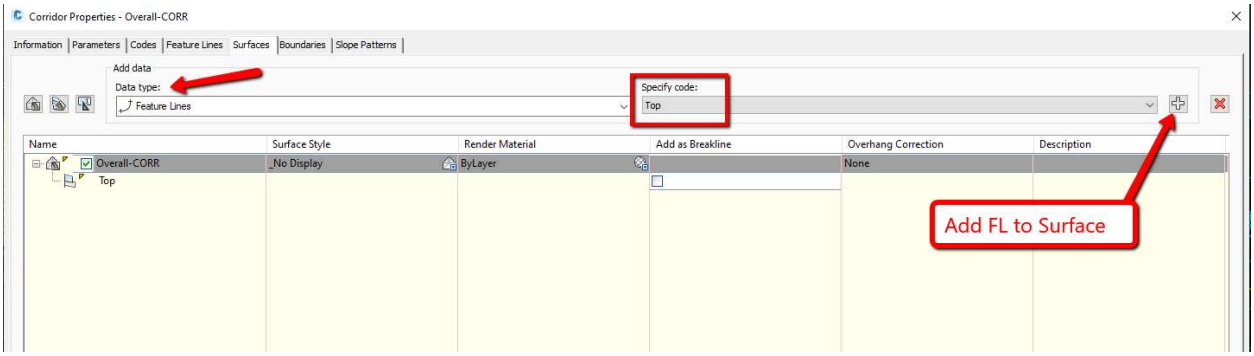
Corridor Surfaces

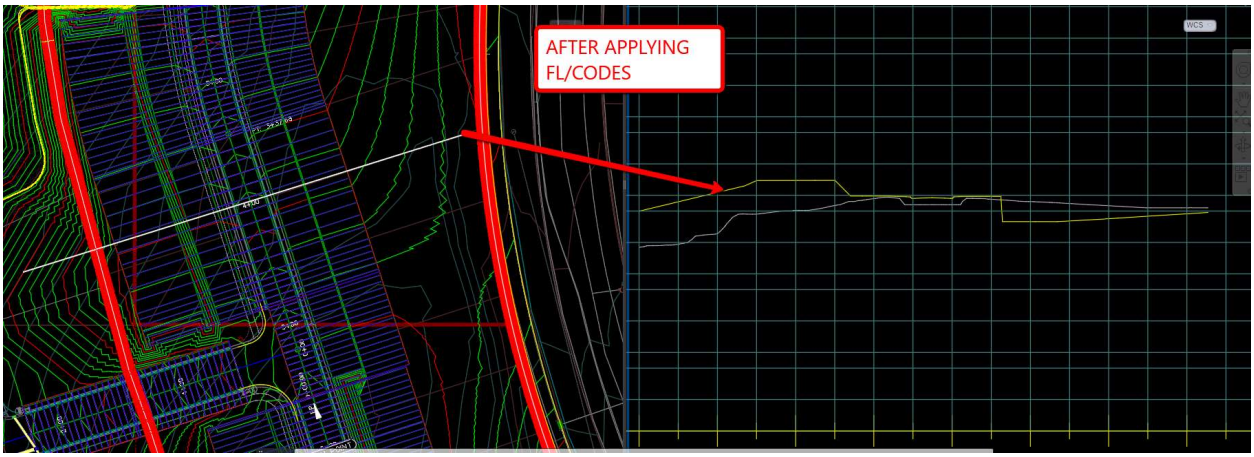
Now you may notice that your surface is not updating accordingly. This is typically due to additional codes or feature lines that you need to add to your surface. Let's quick check our corridor surface and add additional data.

For this session, the Finished Ground has been created. We will add data, and we will create a new surface for the subgrade/datum.



1. Select your Corridor, right click (or ribbon) and go to Corridor Properties.
2. Switch to the Surfaces Tab
3. Expand the surface that is there (Overall-CORR), change the data type to Feature Lines, choose Top from the Specify Code (and then Hinge) and add it to your surface. Select OK

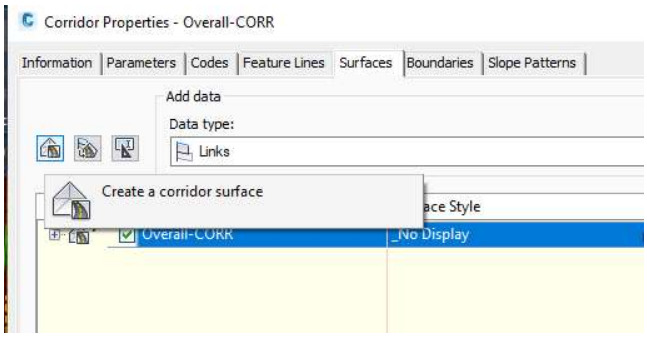




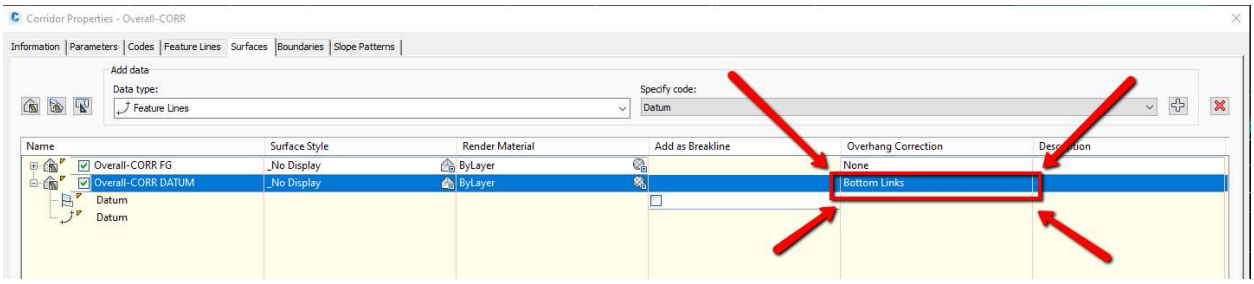
We then need to create the subgrade/datum surface. This is the surface we will run all earthwork calcs on.

Create FG-Datum Surface

1. Select your Corridor, right click (or ribbon) and go to Corridor Properties.
2. Switch to the Surfaces Tab
3. On the far left, select Create a corridor surface



4. Name it Overall-CORR DATUM. We now need to add data. From the Data Type (Links), add in the Datum Code.
5. Switch Data type to feature lines, and add Datum as well.
6. On subgrade/datum surfaces, you MUST select the Bottom Links under Overhang Correction. This will force vertical surfaces, and this must be set.



You now have your subgrade surface. Add any feature lines that you think will be crucial to design. Typically, they are:

- Along Boundary (Existing tie ins)
- Ponds
- Swales
- Any other feature you want in your surface!

The final step prior to calculating volumes, is to create a datashortcut for your Datum surface. No explanation needed here, hopefully you are familiar with that process.

We are ready to analyze and create some exhibits!

Volume Analysis Options

Surface Comparison

Probably the simplest way to check earthwork volumes in Civil 3D. Creating a volume surface (TIN or GRID) is the comparison between a Base Surface (typically Existing ground) and a Comparison Surface (typically Finished Ground DATUM/Subgrade).

You can also apply a cut and/or fill factor and display both your unadjusted raw numbers, or your adjusted numbers.

I use datashortcuts, and create a whole new file that store my mass grading volumes and is dynamic to all changes.

Create a Volume Surface

1. Open the VolumeTemplate.dwg file.
2. Save the file as Volume.dwg.
3. Data Shortcut in your EG and the FG-Datum surface.
4. Right Click on Surfaces in Prospector, or select surfaces > Create Surface from the Home tab of the ribbon.
5. Specify the Surface Type, for this we will use a TIN Volume Surface
6. Name your surface OverallVolume and set a style. The style typically used to show Cut/Fill is an Elevation Style.
7. Set your Base Surface to Existing Ground
8. Set your Comparison Surface to your Overall Finished Ground (FG-Datum).
9. Select OK and your surface will be created.

From there you can choose to display or report your finding in numerous ways.

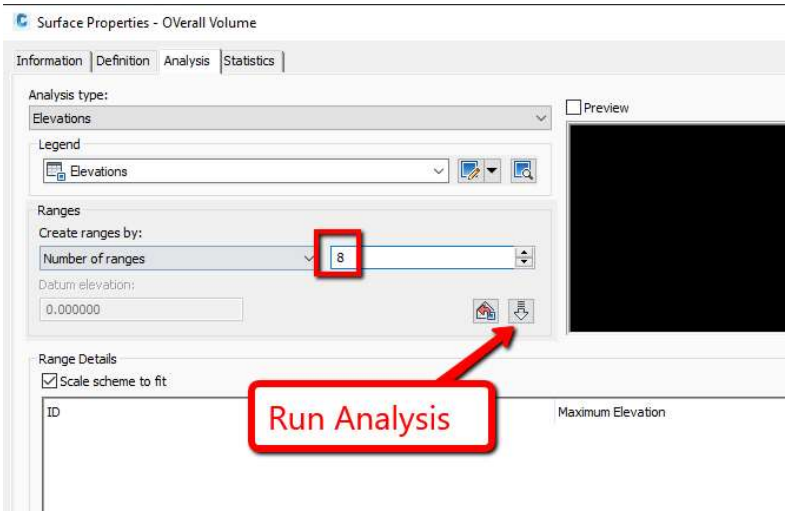
- ***Elevation Analysis.*** By running an elevation analysis, you can display the different intervals of cut vs fill. This is an easy way for others to visualize the volume of work to be done.
- ***Add Spot Elevations on Grid.*** This will allow you to label the cut or fill depths along a specified grid pattern. You can also do some cool expressions that show the FG, the EG and the difference between the 2.
- On the Statistics Tab, expand Volume to display your volume information. ***NOTE: You can right and copy to clipboard, then paste the text in email, word or in AutoCad as MTEXT!***

Let's do it!!

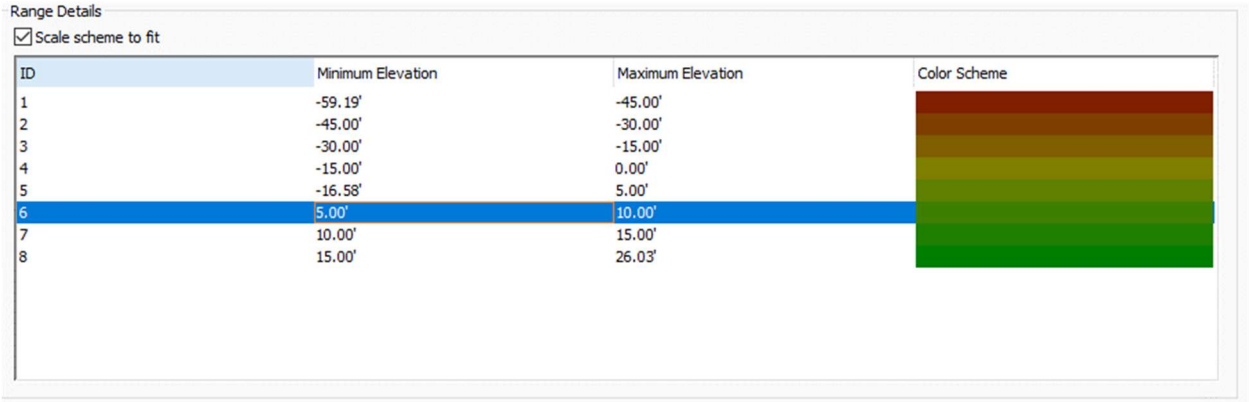
Surface Volume Analysis

We can adjust the display of our surface by performing an Elevation Analysis within the Surface properties. Here we can adjust color, ranges, etc to get the optimal visual we want our client to see.

1. Select your Volume Surface and go to Surface Properties
2. Switch to the Analysis tab
3. For the Analysis type, choose Elevations
4. For the number of Ranges, change it to 8 and press the Run Analysis option.



5. You can modify all aspects of the range details. Change the number and change the colors as you see fit. Then select OK.

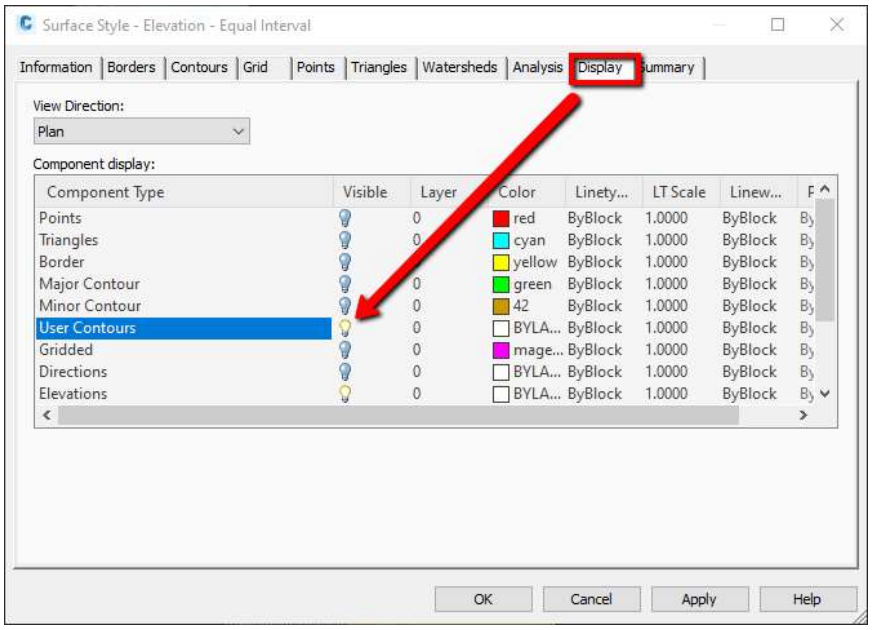


Beautiful right??? Let's keep going!

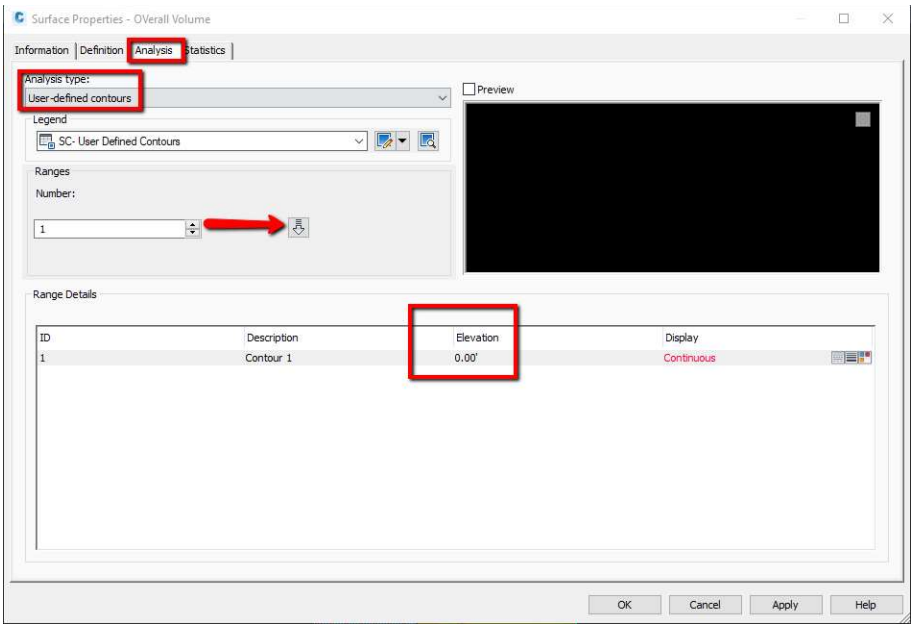
User Contour Analysis

I like to know where the transition to cut and fill is taking place. For several reasons, in the cut areas we may have different subsidence/shrink/swale/refill to calculate for and same goes for the fill areas. Both areas may be assigned a different cost, and some areas of cut may not require the same amount of pre-stripping as others. For this exercise, we will simply perform a User Defined Contour analysis to display our 0 elevation.

1. Select your volume surface, right click and choose Edit Surface Style
2. Switch to the Display tab and turn on User Contours. Select OK.



3. Select your Volume Surface and go to Surface Properties
4. Switch to the Analysis tab
5. For the Analysis type, choose User-defined contours.
6. For the number of Ranges, change it to 1 and press the Run Analysis option.
7. Change the Elevation to 0 and select OK



NOTE: You can extract those contours as polylines and use parcel to quickly calculate the area!!

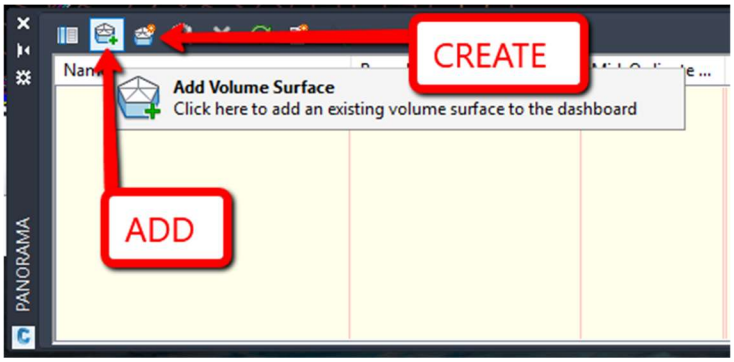
Volume Dashboard

The Volume Dashboard takes a simple volume surface just one step further by allowing you to created “Bounded Volumes”. This will easily create volumes of specified areas, usually by specifying a polyline, without the need for multiple volume surfaces. So, if you have phases of a master development for example, you can easily copy in your phase lines and use those for the bounded volume areas. This is a very simple process as shown below:

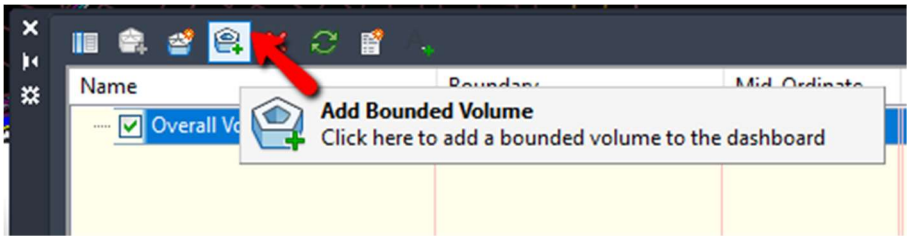
1. In the Volume.dwg file. Import the **Phase Lines.dwg** as a block and explode the block. This consists of several phases of the project, as we will now break out each phase into separate volumes.
2. Select Volumes Dashboard from the Analyze Ribbon.
3. Add (or create) a Volume Surface.

Notes:

- A volume surface must exist in the drawing before this option can be used. If no volume surfaces exist, then you can use the Create New Volume Surface option to create one.
- Data-referenced volume surfaces cannot be added to the Volumes Dashboard directly. However, you can create a volume surface in the current drawing that uses data-referenced surfaces for the base and/or comparison surfaces.
- You can also apply an expansion or compaction factor to the materials.

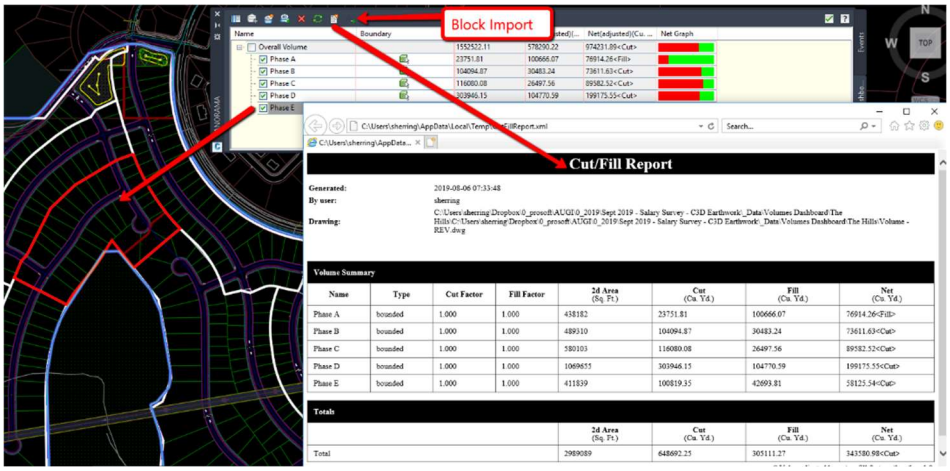


4. With your phase lines located in the drawing, select the Overall Volume from the list, then select ADD BOUNDED VOLUME, then select the polyline representing your area of interest (i.e. phase, sheet, etc)



5. Repeat the steps as needed.
6. From the list within the Volumes Dashboard Grid View, you can rename each of your selections. Notice that as you highlight each row, the polyline will be represented in red on the screen.

There are 2 reporting options, first, you can add a block with the data into your CAD file, second, you can export out an XML report.



Annotate w/ Labels and Tables

This is where you can really do some cool stuff. Giving a volume report works, and is helpful and needed, but showing on the map exactly where cuts and fills are, as well as the larger cut/fill areas is priceless. Contractors can make quick decisions on where to draw material from, or where to stock pile materials. All of these decisions can save time and money!

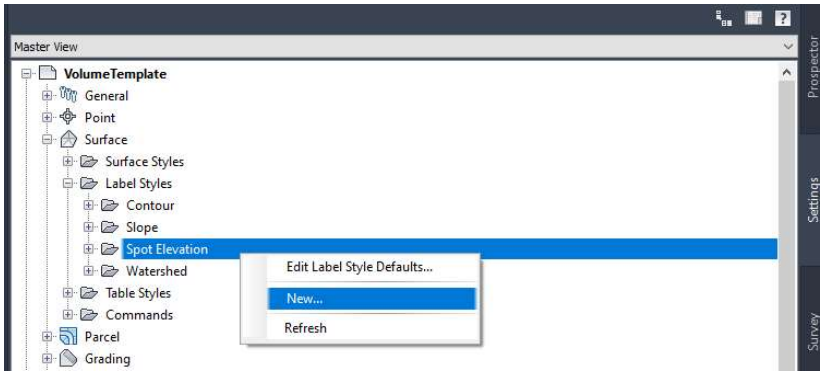
Let's create a quick label and apply it to our surface.

Create Label for Spot Elevations

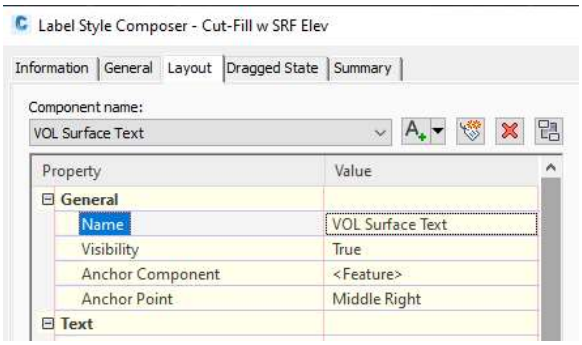
Again, this is just one example, but you can do a lot with labels. For example, expressions can be used to make cut text different then fill text. Those steps are outlined at the end of this document.

For this example, we will create cut/fill labels that show the FG, EG and the cut/fill elevation. We will then use the Create Spot Elevations on grid command.

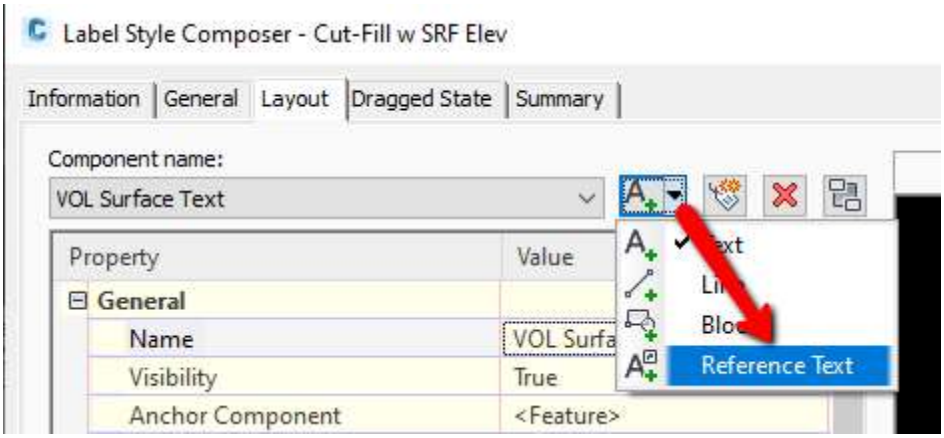
1. On the settings tab, expand Surface, expand Label Styles, right clock on Spot Elevation and select NEW.



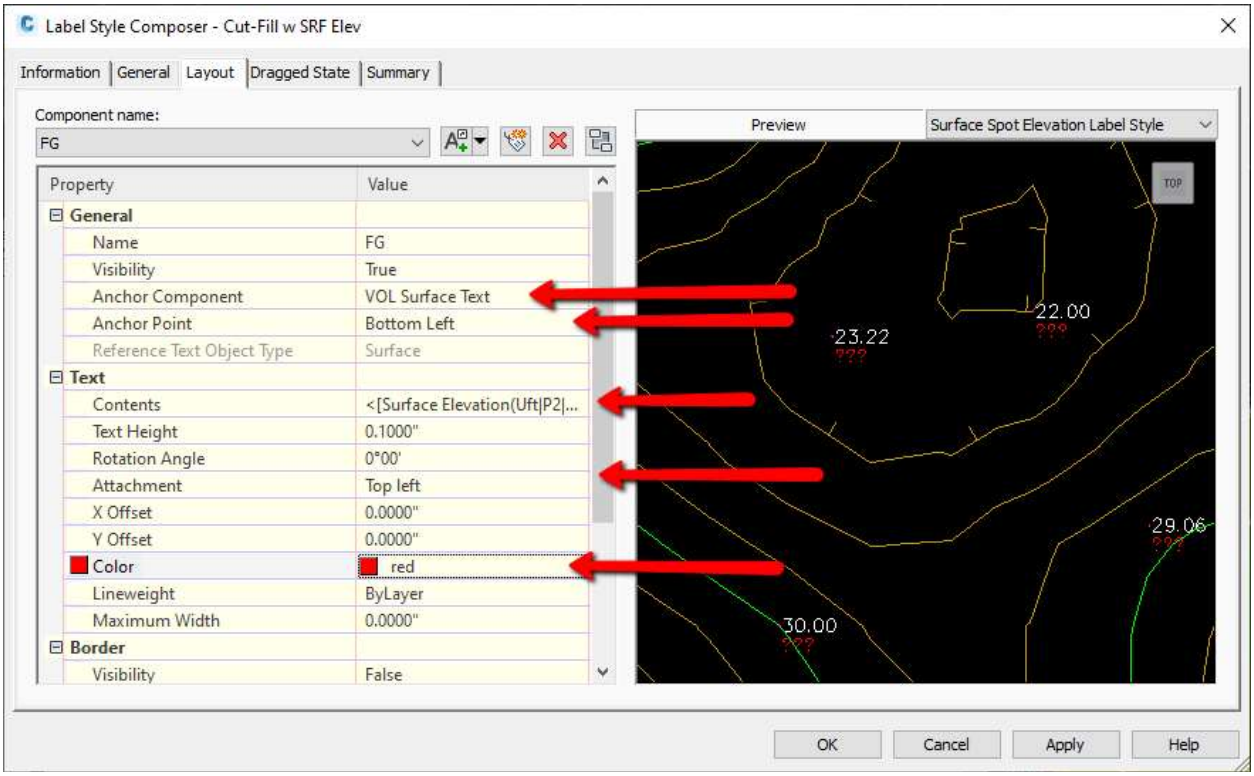
2. Name the style Cut-Fill w SRF Elev
3. Switch to the layout tab. Since this is a volume surface, the initial component will map to the volume surface, and each additional surface will be a Reference text. We will end up with 3 components.
4. Rename the initial component to VOL Surface Text. Leave all other items as is.



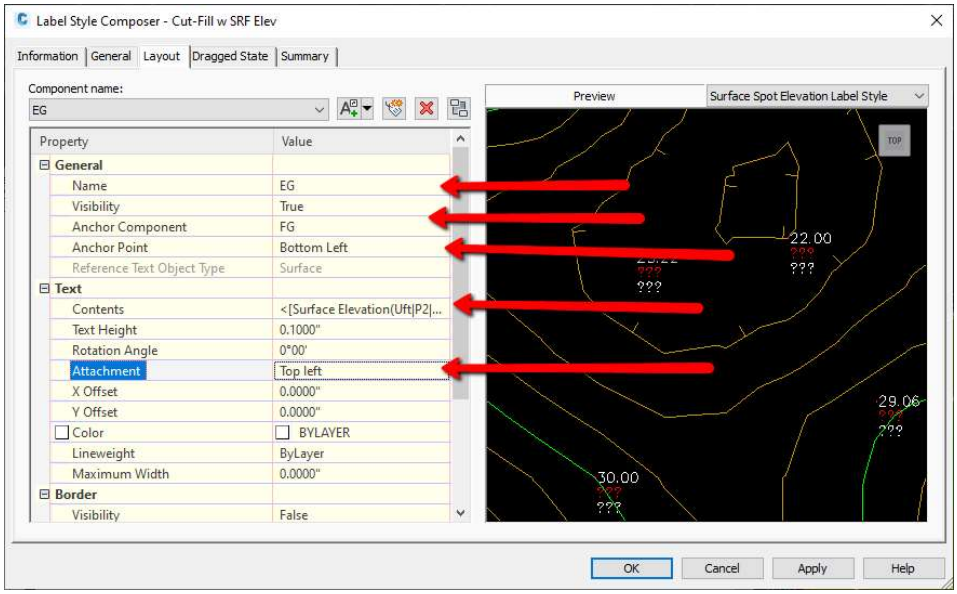
5. Add a reference text as a new component



6. Select Surface as the type and select OK
7. Rename the component as FG, and set the settings as shown below.

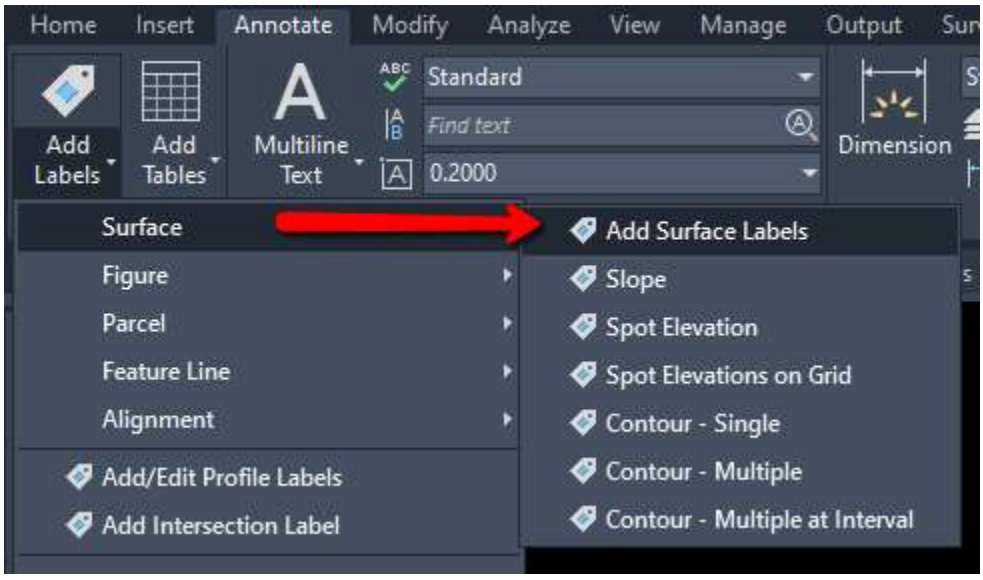


8. Repeat the steps for the EG surface, settings as shown below.

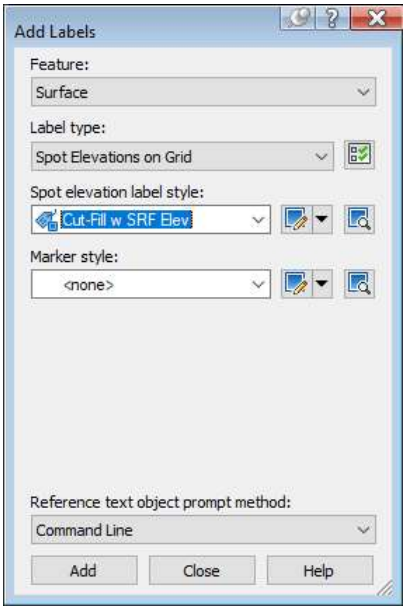


Now to add the labels!

9. Select Add Labels (from Annotate Ribbon), Surface and Add Surface Labels

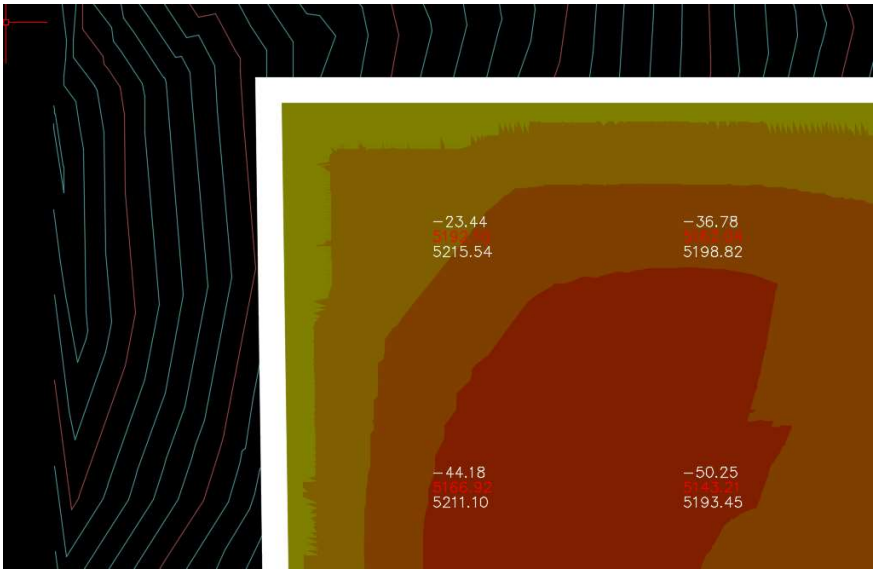


10. Choose Spot Elevations on Grid as the label type, and Cut-Fill w SRF Elev (or whatever you named it!) and the style.



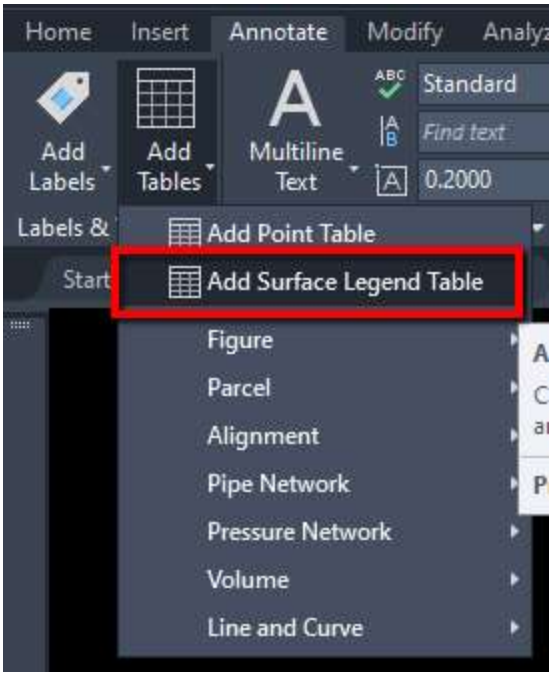
11. Select ADD
12. Select your volume surface
13. Grid Basepoint = bottom left
14. Grid Rotation = 0 (hit enter)
15. Grid Spacing = 100’ (or whatever fits your site best)
16. Specify upper right, anywhere outside of your site to the upper right
17. Select enter to accept
18. Read your command line carefully, specify the FG surface
19. Set the EG surface

DONE!! See the results below.



Create Elevation Table

1. Switch to the annotate tab of the ribbon, choose Add Tables, and select Add Surface Legend Table



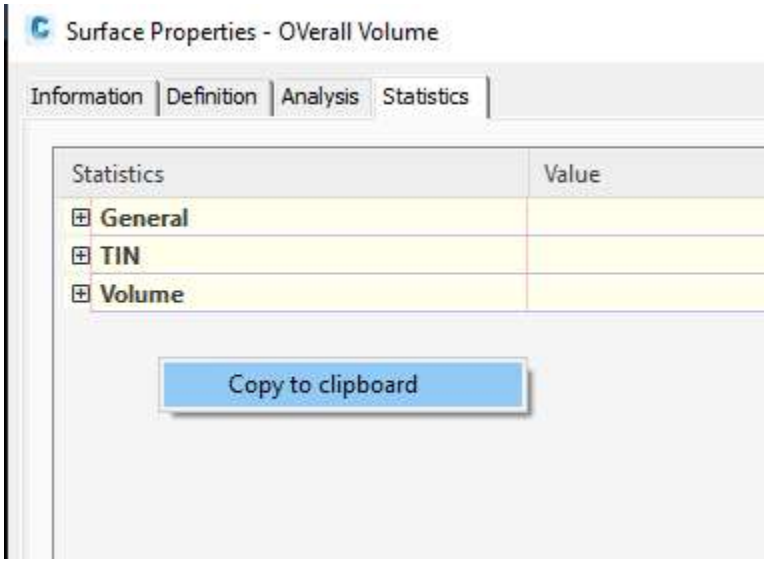
2. Right click to select your volume surface from a list, or select it from the screen.
3. In your command line, select Elevation
4. Select Dynamic (Not sure why there is even a static option!)
5. Place the table anywhere on your screen.

Elevations Table

Number	Minimum Elevation	Maximum Elevation	Area	Color
1	−59.19	−45.00	20515.11	
2	−45.00	−30.00	160783.36	
3	−30.00	−15.00	947658.26	
4	−15.00	0.00	3000559.72	
5	−16.58	5.00	4368302.86	
6	5.00	10.00	896960.69	
7	10.00	15.00	338781.57	
8	15.00	26.03	140053.14	

Insert Volume Statistics

1. Select your volume surface, right click, go to surface properties.
2. Switch to the Statistics tab, right click in any “grey” area and select Copy to clipboard
3. Select OK (or cancel)



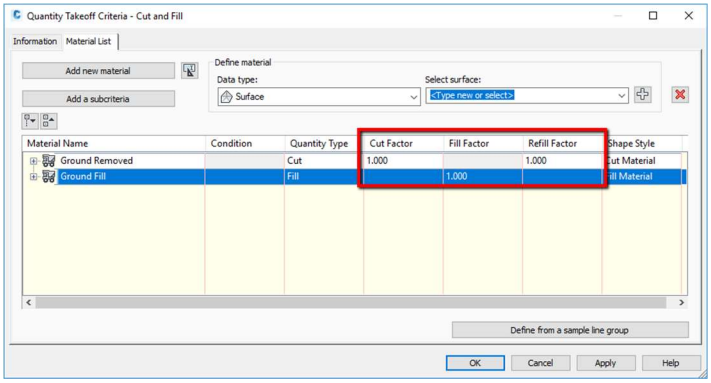
4. You can paste the text anywhere you want, just CTRL+V into email, word, MTEXT and anywhere else!
    a. This is static text, not dynamic to any changes.

Sample Lines / Materials Takeoff

Sample Lines are simple to produce in Civil 3D, and many users product them just to create section views. But you are only a couple steps away from using those sample lines to compute materials for Cut, Fill, Refill and other roadway materials. Two things needed prior to computing the materials.

1. Create a DATUM Surface. In your Corridor, be sure to create a DATUM surface for the bottom layer, or subgrade, of your model.
2. Create Sample Lines – Be sure to sample at least your EG, your DATUM surface and your corridor model itself.

Once you have created your sample lines, select one of the sample lines and from the ribbon choose Compute Materials. Your Materials List is defined within a style, as shown below. In here you can apply Cut, Fill and Refill Factors if needed.

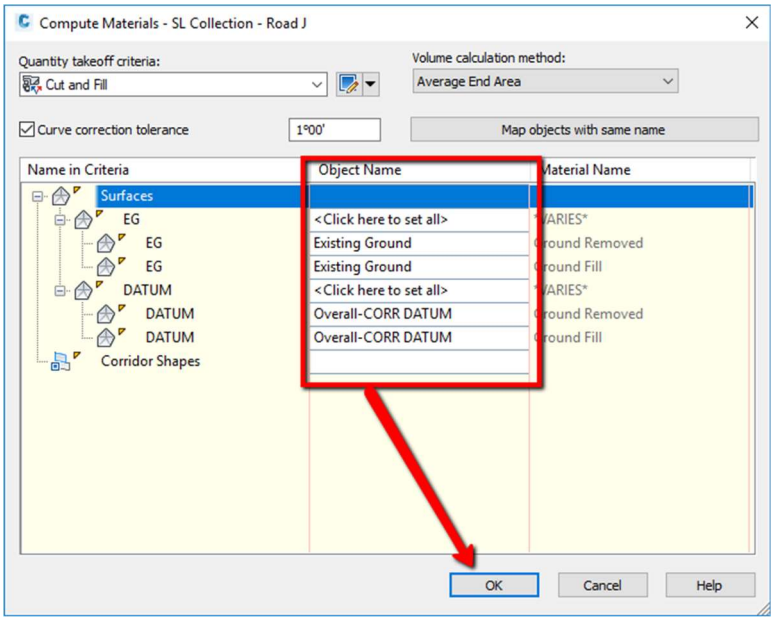


- CUT Factor – Commonly referred to as SWELL. Expansion value as dirt that is typically in place, will have a greater volume once moved.
- FILL Factor – Commonly referred to as SHRINKAGE. As material compacts you typically need more than what your raw number states.

Note: For example, for a material that compacts to 93% of its original value when used as fill, enter 1.075 (which is derived by dividing 1.0 by .93) as the fill factor to compensate for the extra material that must be added.

REFILL Factor - As this factor depends on the cut material type and other considerations, it can run across a range. A heavy aggregate might have a Refill factor of 1.0, while fill cut from a rock ledge might have a Refill factor of 1.2. Not all cut material may even be reusable, as when it is cut from bog or marsh. The refill factor would then be 0.

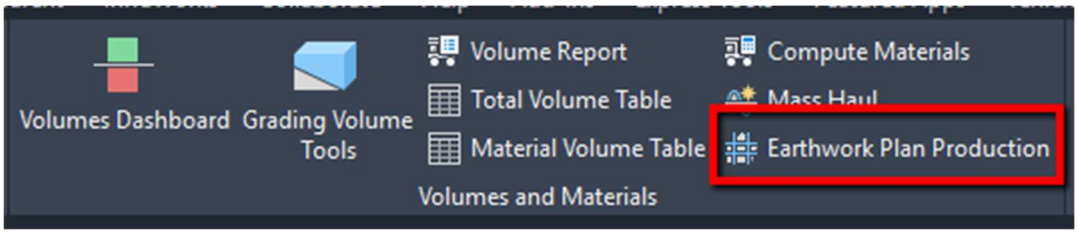
Once your criteria style has been defined, simply map the Object Name to the proper Criteria/Material and select OK.



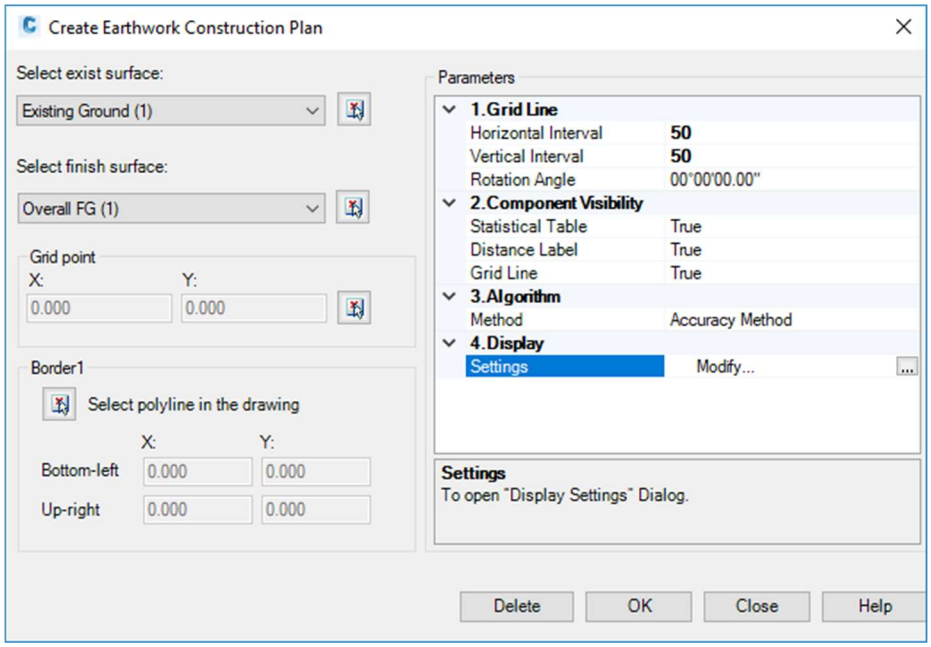
Your material has been computed, but may look like nothing has happened. You now need to choose how to display the data and this can be done in several different ways.

1. **<u>Generate Volume Report</u>**
    a. This will display the calculations based on the Average End section method and give you volumes per station (based on Sample Line Interval) and a Total Cumulative Volume.
2. **<u>Create a Total Volume Table</u>**
    a. Allows you to setup a table style and display all the data you would like.
3. **<u>Display with Section Views as a Table</u>**
    a. If you have your section views imported, you can add a simple table to each view with the specified materials!

Eearthwork Plan Production



You can use the Earthwork Plan Production command to insert labels in a grid and tables that contain information about the volume of the earthwork between two TIN surfaces. This option gives contractors and job foreman a lot more info that creating a surface volume alone. There are several simple settings to be aware of as shown below.



The horizontal and vertical interval will give you cut-fill info at all 4 corners of the grid lines, as well as a total volume within the specified grid pattern. You can choose how the data is displayed in the setting, but be aware, this option is NOT DYNAMIC, meaning that if anything changes, you'll need to re-run the analysis.

There are 3 algorithm methods:

Accuracy Method

Calculates the volume from a volume surface that is created between the two TIN surfaces. This is the default method.

Note: This method should be used in cases where the grids are cut to irregular shapes at the surface boundary.

Triangular Prism Method

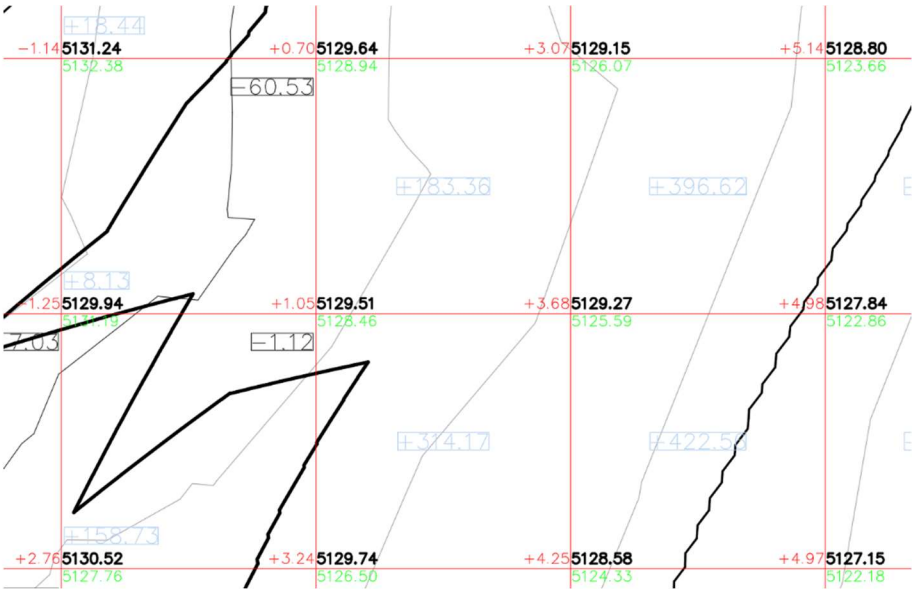
Calculates the volume from triangular prisms. The area to be calculated is divided into triangular prisms, and the volume is calculated for each triangular prism and then summed.

Note: This method should not be used in cases where the Horizontal Interval and Vertical Interval are set to different values.

Cuboid Prism Method

Calculates the volume from cuboid prisms. The area to be calculated is divided into cuboid prisms, and the volume is calculated for each cuboid prism and then summed.

The finished product is fantastic and unlike any other option in Civil 3D!



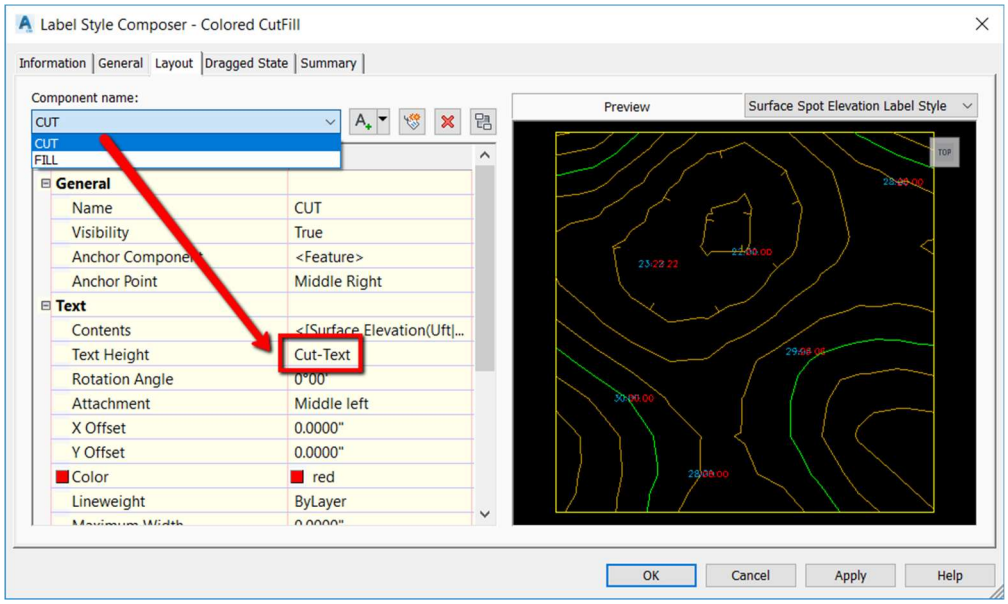
Expression for Cut / Fill Text

Another useful example for expressions is to use them to aid in labeling cut vs. fill labels in a volume surface. For example, you may want to display your CUT in **red**, and you FILL in **blue**. To do so, we will setup a couple quick expressions.

1. First, ensure you have a VOLUME surface created. This goes without explanation, but thought I would mention it anyway!
2. Create two expressions, one for the Cut Text height and one for the Fill Text height.
3. Name this first expression Cut-Text. Use this as the expression:
    a. ***IF({Surface Elevation}<0,0.10/12,0.00000001)***
4. Name this second expression Fill-Text. Use this as the expression:
    a. ***IF({Surface Elevation}<=0,0.12/12,0.00000001)***

What we are doing here, is creating a super small text that will NOT show up once we place our labels. These expressions are slightly different, we won't use these in our label composer, but we will use these to adjust the text height and differentiate Cut v. Fill.

5. Create a label style that has 2 components, Cut and Fill text. These components reference the Surface Elevation, but in the text height property, you will set the corresponding expression (Cut/Fill).
6. Change the CUT component color to RED.
7. Change the FILL component to BLUE.



8. Test this out by using your new label style to label a surface!!

Machine Control Discussion

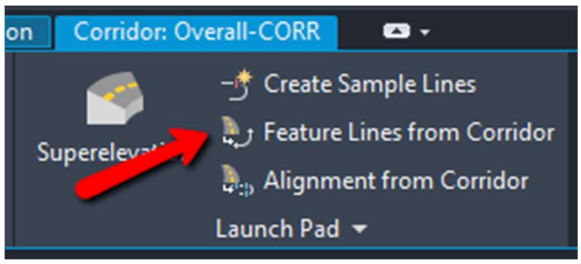
Your corridor model is key to an accurate surface, and can be used to extract materials volumes such as cut/fill as well as roadway materials such as Pavement, Subbase, RoadBase, Concrete, etc. It is also very important when creating Machine Control models, and knowing what surfaces/models are needed is key. Here are a few things to keep in mind.

Typically, a project utilizing machine control guidance needs the following:

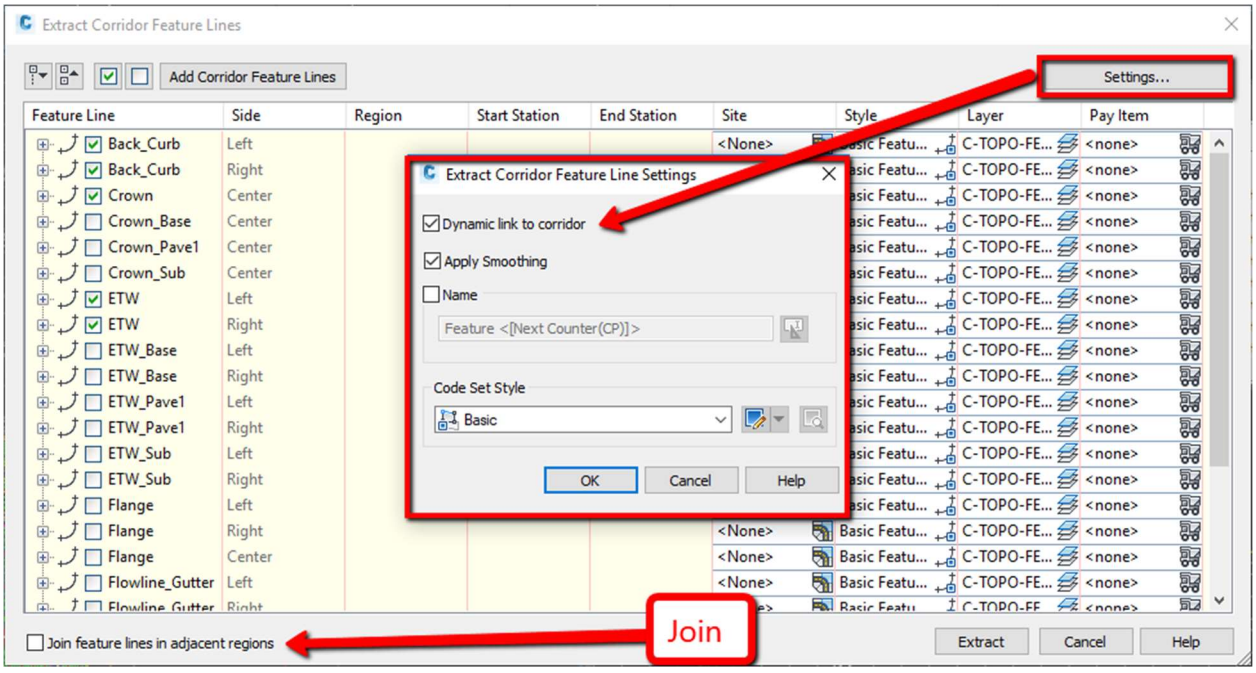
- Road Alignment – LandXML works great.
- Proposed Surfaces – LandXML
  - Existing Ground Surface
  - Top/FG Surface – This allows them to show design intent, even when doing rough grading
  - BaseCourse
  - DATUM – For grading purposes
- Survey Control
- DXF/DWG – Many times the contractor can utilize a DXF or DWG for the surface, but you will want to turn on the TIN line, and export it down to an earlier version.

Extracting Feature Lines is also very helpful to contractors. "Steer Lines" are helpful to extract, and those lines can be the crown, edge of asphalt or curb line for example. These are simple to extract from your corridor, and you can even join lines together from region to region.

1. Select your corridor and choose Feature Lines from Corridor from the Ribbon.



2. Select the Feature Lines you wish to extract.
3. From the Settings, you can choose to keep them dynamically linked to the Corridor, or take the dynamic linking off.
4. You can also select to "Join Feature Lines in Adjacent Regions"
5. Confirm your selections and select EXTRACT. That's all!!
6. If needed, Export you Civil 3D drawing out to a previous version. The new export option in 2020 is great for that.


Extract Corridor Feature Lines
Add Corridor Feature Lines
Settings...
Feature Line
Side
Region
Start Station
End Station
Site
Style
Layer
Pay Item
Back_Curb Left
Back_Curb Right
Crown Center
Crown_Base Center
Crown_Pave1 Center
Crown_Sub Center
ETW Left
ETW Right
ETW_Base Left
ETW_Base Right
ETW_Pave1 Left
ETW_Pave1 Right
ETW_Sub Left
ETW_Sub Right
Flange Left
Flange Right
Flange Center
Flowline_Gutter Left
Extract Corridor Feature Line Settings
Dynamic link to corridor
Apply Smoothing
Name
Feature <[Next Counter(CP)]>
Code Set Style
Basic
OK
Cancel
Help
Join feature lines in adjacent regions
Join
Extract
Cancel
Help