

Drawing a Tank in SurvCADD Including Calculating Cut and Fill

This instruction sheet will guide you through drawing a manure tank and calculating volumes of cut and fill. SurvCADD modules are displayed as **{COGO-Design}**, main menus are displayed as **[Points]**, and submenus and menu commands are displayed as **<Edit Points>**. A table on page 7 will assist in the data entry and organization.

Create a grid of the existing surface using MD-SC-22 – Creating 3D Surfaces
Contour the site using the appropriate instruction sheet (MD-SC-24 or MD-SC-25)

DRAW A CIRCLE THE SAME SIZE AS TANK

While elevations cannot be set for the circle itself, by locating a circle first, the tank polyline can easily be drawn and moved, using the center of the circle as a snap point. Create a new layer for the circle, and new layers for the tank.

- 1) **{DTM-Contour} → [Draw] → <Circle>**
 - a. Pick the location for the center of the tank by **clicking** it
 - b. **Type** in the **tank radius** and press “Enter” *C
- 2) **{DTM-Contour} → [View] → <Layer Control>**
 - a. Create a new layer by clicking the “New Layer” button
 - b. Type in a layer name of “**COGO – Circle**”
 - c. Create layers for “**COGO – tank**”, “**COGO - tank-cut**”, and “**COGO - tank-fill**”
 - i. Attribute the layers as you like (assign a different color to each layer)
 - d. Click “OK” when done
- 3) Add the circle drawn above to the “**COGO – Circle**” layer

Fill out the table on page 7 of this instruction sheet to simplify data entry.

DRAWING THE TANK POLYLINE

Using the circle as a template, a tank polyline can be drawn and given an elevation.

- 4) Make “**COGO – tank**” the active layer
- 5) Draw a polygon: **{AutoCAD Module} → [Draw] → <Polygon>**
 - a. Number of sides: **50** and press “Enter”
 - b. **Pick the center of the circle** already drawn (snap to center of circle)
 - c. Press “Enter” to Inscribe the polygon inside a circle
 - d. **Type** in the **tank radius** and press “Enter” *C
- 6) Freeze the “**COGO – Circle**” layer
- 7) Set the finished floor elevation: **{DTM-Contour} → [Edit] → <3D Entity to 2D>**
 - a. **Type** in the **elevation** of the finished floor of the tank *E

- b. **Select the tank polyline.**
- c. Press “**Enter**” to end the routine

DRAWING THE EDGES OF THE EXCAVATION

By offsetting the 3D-polyline representing the bottom of the tank, the edges of the excavation can easily be created.

- 8) Freeze any contours that may be active.
- 9) Create a cut polyline: {DTM-Contour} → [3Dpoly] → <Offset 3D Polyline>
 - a. Press “**Enter**” for the Interval offset method
 - b. Enter “**3.5**” and press “**Enter**” for the horizontal offset (includes tank wall and room to place forms, use more if needed)
 - c. Enter “**-1**” and press “**Enter**” for the vertical offset (cut to excavation depth from the finished floor)
 - d. **Select the tank polyline** and **click outside** the tank to offset it outside of the bottom of the tank.
 - e. Press “**Enter**” to end the routine
- 10) Place the new polyline on the “**COGO - tank-cut**” layer.
- 11) Run the Design Pad Template to create the cut: {DTM-Contour} → [Site] → <Design Pad Template>
- 12) Select the following in the “**Design Pad Template**” box:
 - a. Source of Surface Model: **Surface File**
 - b. Slope Direction from Closed Polylines: **Outside**
 - c. Design Slope Format: **Ratio**
 - d. Round Exterior Corners: **Checked**
 - e. Draw Side Slope Polylines: **Checked**
 - f. Side Polyline Spacing: **25**
 - g. Cut/Fill Factors: **1.000**
 - h. Pad Layer Name: **PAD – Tank Cut**
- 13) Click “**OK**” when done
- 14) Select the excavation polyline on the “**COGO – tank-cut**” layer (the offset polyline).
- 15) In the “**Select the Slope Target Surface**” dialog box that appears, navigate to and **double-click** the grid file to use (your existing grid)
- 16) Enter the fill slope ratio: **0.1**
- 17) Enter the cut slope ratio: **0.75** or flatter
- 18) Enter the excavation pad elevation: **1.0’ below** the finished floor elevation ***G**
- 19) Press “**Y**” to calculate the earth work volumes
- 20) The “**Pad Report**” displays the total cut required
 - a. Save it to file by hitting the “**Save**” button
 - b. Print for your records using the “**Print**” button
- 21) Press “**Exit**” when done

- 22) Press “**Enter**” to not adjust and redesign the pad
- 23) Type “**Y**” and then “**Enter**” to write the surface to a grid file
- 24) Navigate to your drawing folder and **save the grid** with a recognizable name including notation of **Tank_Cut** (example: Smith_Tank_Cut.grd)
- 25) Press “**N**” and then “**Enter**” to not trim contours
- 26) Press “**N**” and then “**Enter**” to contour the pad

DRAWING THE TANK EDGES, FILL EDGES, & FILL PAD

By offsetting the 3D-polyline representing the bottom of the tank, the edges of fill can easily be created.

- 27) Turn off layers “**COGO - tank-cut**” and “**PAD – Tank Cut**”
- 28) Offset the tank polygon to create the top of the wall on the inside of the tank: **{DTM-Contour} → [3Dpoly] → <Offset 3D Polyline>**
 - a. Press “**Enter**” for the Interval offset method
 - b. Enter “**0.1**” and press “**Enter**” for the horizontal offset
 - c. Enter the **tank height** and press “**Enter**” for the vertical offset (height of wall) ***A**
 - d. Select the **tank polyline** and **click outside** the tank to offset the line and create the top of the wall
 - e. Press “**Enter**” to end the routine
- 29) Offset the tank polygon to create the top of the wall on the outside of the tank: **{DTM-Contour} → [3Dpoly] → <Offset 3D Polyline>**
 - a. Press “**Enter**” for the Interval offset method
 - b. Enter the **thickness of the wall in feet** and press “**Enter**” for the horizontal offset (typically 0.67 or 0.75) ***D**
 - c. Enter the **tank height** and press “**Enter**” for the vertical offset (height of wall) ***A**
 - d. Select the **tank polyline** that represents the **bottom inside** of the tank and **click outside** the tank to offset the line and create the outside top of the wall. Note you probably will have to **zoom in** close to the lines to see any separation.
 - e. Press “**Enter**” to end the routine
- 30) Offset the tank polygon to create a fill line on the outside of the tank: **{DTM-Contour} → [3Dpoly] → <Offset 3D Polyline>**
 - a. Press “**Enter**” for the Interval offset method
 - b. Enter the “**5**” and press “**Enter**” for the horizontal offset (creates a ~4’ level section around tank before the fill slopes off)
 - c. Enter the **maximum fill height (typ. tank height – 0.5’)** and press “**Enter**” for the vertical offset (This will be site specific. This assumes that fill will come to within 0.5’ from the top of the tank at the highest point. If distance to the top of the tank needs to be greater, use that distance instead of the 0.5’) ***I**
 - d. Select the **tank polyline** that represents the **bottom inside** of the tank and **click outside** the tank to offset the line and create the fill polygon. Note you probably will have to **zoom in** close to the lines to see any separation.

- e. Press “**Enter**” to end the routine
- 31) Place the outermost polyline on the “**COGO - tank-fill**” layer.
- 32) Turn on the existing contours if they are off.
- 33) **Freeze** the “**COGO – tank**” layer
- 34) Run the Design Pad Template to draw the fill around the tank: {DTM-Contour} → [Site] → <Design Pad Template>
- 35) Select the following in the “**Design Pad Template**” box:
- a. Source of Surface Model: **Surface File**
 - b. Slope Direction from Closed Polylines: **Outside**
 - c. Design Slope Format: **Ratio**
 - d. Use Sloped Pad Design: **Checked**
 - i. If the fill will be at the same elevation around the tank, do not select *Use Slope Pad Design*.
 - ii. **Slope percent**: use up to a 3’ elevation difference divided by the distance across your fill pad diameter times 100. To determine the elevation difference, look at the elevation difference of the existing contours running through the tank. If the elevation difference is equal to or greater than 3’, use 3’. If less than 3’, use the existing elevation difference. ***K, L**
 - iii.
$$\text{Slope} = \frac{3'}{\text{Fill Diameter}} \times 100 \quad \text{*N,O}$$

(1) Example: Tank diameter = 90’, fill pad diameter = 90 (tank) + 5.0 (0.67 (wall) + 4.33 (level)) + 5.0 = 100’
 - e. Round Exterior Corners: **Checked**
 - f. Draw Side Slope Polylines: **Checked**
 - g. Side Polyline Spacing: **25**
 - h. Cut/Fill Factors: **1.000**
 - i. Pad Layer Name: **PAD – Tank Fill**
- 36) Click “**OK**” when done
- 37) **Click** the fill polyline on the “**COGO - tank-fill**” layer
- 38) In the “**Select the Slope Target Surface**” dialog box that appears, navigate to and **double-click** the existing ground grid file to use
- 39) Enter the fill slope ratio: **3**
- 40) Enter the cut slope ratio: **0.75** or flatter
- 41) Enter the pad elevation: **enter the lowest elevation of the fill pad *M**
- a. If the fill is to come within 0.5’ of the top of the tank, the lower edge of fill should be 3.5’ below the top of tank elevation, assuming a 3’ backfill difference. If the distance the tank is out of the ground is greater, add the depth out of the ground to fill elevation difference around the tank.

b. If the *Use Slope Pad Design* was not checked, this prompt will not occur. Instead, you will be prompted for the pad elevation.

42) Pick the first point then the second point to define the direction of the slope.

a. The first point is the lower edge of fill, the second the highest.

b. If you did not select the *Use Slope Pad Design*, this will not be an option.

43) Type “N” and “Enter” to calculate the earth work volumes

44) Type “N” then “Enter” to not adjust and redesign the pad

45) Type “N” and then “Enter” to not write the surface to a grid file

46) Press “Y” and then “Enter” to trim the contours

47) Press “Y” and then “Enter” to retain the trimmed contours

48) Press “N” and then “Enter” to leave the trimmed contours on their current layer

49) Press “Y” and then “Enter” to contour the pad

a. For contouring, select the options desired in the same way as using the main contouring function.

b. Change the layer name (i.e. **CTR – Proposed**)

c. Click “OK” once options are set

50) Press “N” and then “Enter” to not join the existing and proposed contours

51) Trim any proposed contours inside of the inner fill polyline, if they exist

CREATE A GRID FILE OF THE TANK AND FILL, DETERMINE FILL VOLUME

In this section, a grid file will be created from the tank and fill layers.

52) Turn on the “**COGO – tank**” layer

53) Draw the fill polyline against the tank using the polyline representing the inner edge of the fill pad: **{DTM-Contour} → [3Dpoly] → <Offset 3D Polyline>**

a. Press “Enter” for the Interval offset method

b. Enter the “**5.0 - thickness of the wall in feet**” and press “Enter” for the horizontal offset (typically 4.33 or 4.25) *D

c. Enter the “**0.1**” and press “Enter” for the vertical offset (slight slope on level area)

d. Select the **inner pad polyline** on the “**PAD – Tank Fill**” and **click inside** of it to offset the line and create the fill line against the tank

e. Press “Enter” to end the routine

54) **{DTM-Contour} → [View] → <Isolate Layers>**

a. Select the “**COGO – Tank**” and the “**PAD – Tank Fill**” layers and press “Enter” when done

b. Press “Enter” to not retain points

55) **{DTM-Contour} → [DTM] → <Make 3D Grid File>**

a. Name the grid file with the notation of “*Tank Fill*” and press “Save”

b. Type “F” and then “Enter” to use the position from the original grid file

c. Select the **original ground grid** file and press “Open”

d. Press “Enter” to accept the default low elevation

- e. Press “**Enter**” to accept the default high elevation
 - f. Press “**Enter**” to accept triangulation as the modeling method
 - g. Press “**Enter**” to accept Auto as the triangulation mode
 - h. Type “**ALL**” and press “**Enter**” to select all objects
 - i. Press “**Enter**” to end the routine
- 56) Restore the frozen layers: {DTM-Contour} → [View] → <Restore Layers>
- 57) Create a proposed grid: {DTM-Contour} → [DTM] → <Merge Grid Files>
- a. Find the **existing ground grid** file and press “**Open**”
 - b. Press “**Enter**” to not extrapolate grid to full size
 - c. Find the **tank fill grid** created above and press “**Open**”
 - d. Press “**Enter**” to not extrapolate grid to full size
 - e. Select the **outermost “PAD – Tank Fill”** polyline for the inclusion line and press “**Enter**”
 - f. Press “**Enter**” for no exclusion lines
 - g. **Name the merged grid** with a name like “*Smith Proposed Fill*” and press “**Save**” when done
- 58) Turn on the “**PAD - Tank Cut**” layer
- 59) Calculate the fill volume: {DTM-Contour} → [DTM] → <Two Surface Volumes>
- a. **Select the outer edge** of the outermost *PAD (Cut and Fill)* layer(s) when asked to select the inclusion polyline and then press “**Enter**”
 - b. Press “**Enter**” for no exclusion lines
 - c. **Select the CUT file** as the base grid and press “**Open**”
 - d. **Select the Proposed Fill file** as the final grid file and press “**Open**”
 - e. Select your preferences for the volume report and press “**OK**”. See MD-SC-47A for options.
 - f. The “**Volume Report**” displays the total cut required
 - i. Save it to file by hitting the “**Save**” button
 - ii. Print for your records using the “**Print**” button
- 60) Freeze the “**PAD - Tank Cut**” layer

Data Input Table for MD-SC-48 - Drawing a Tank in SurvCADD Including Calculating Cut and Fill

Use this table to help you input data when creating a tank using this Instruction Sheet. Fill in the non-shaded cells under “Value” and calculate the shaded cells. The IS Step column refers to what step in the instruction sheet the data is used. A “*G” in the instruction sheet refers to the value in this table on the line specified.

Input Line	Input	Unit	Description	Calc.	IS Step	Value
A	Tank Height	ft	Wall Height (Typ. 8, 10, 12, 14)		28c	
B	Tank Diameter	ft				
C	Tank Radius	ft	1/2 Diameter	$B / 2$	1b, 5d	
D	Wall Thickness	ft	Design Dependent		29b, 29c, 53b	
E	Finished Floor Elv.	ft			7a	
F	Top of Tank Elv.	ft	Finished Floor + Tank Height	$E + A$		
G	Excavation Elv.	ft	Finished Floor - 1.0' (typ.)	$E - 1.0'$	18	
H	Minimum Wall Height Above Ground	ft	Site Dependent (min. 0.5')			
I	Max Fill Height	ft	Tank Height - Wall Height Above Ground	$A - H$	30c	
J	Max Fill Elv.	ft	Finished Floor Elv. + Max Fill Height	$E + I$		
K	Elevation Difference Across Tank (Existing)	ft	Use the existing contours to find the elevation difference		35d	
L	Elevation Difference of Proposed Fill	ft	Determine fill elevation difference. If Existing is 3.0' or greater, use 3'. Use existing difference if less.		35d	
M	Minium Elevation of Fill Against Tank	ft	Max Fill Elv. - Proposed Elv. Difference	$J - L$	41	
N	Fill Pad Diameter	ft	Tank Diameter + 10.0' (typ.)	$B + 10.0'$	35d	
O	Fill Pad Slope	%	Proposed Fill Elevation Difference / Fill Pad Diameter	$L / N * 100$	35d	