U.S. DEPARTMENT OF AGRICULTURE
PA - NATURAL RESOURCES CONSERVATION SERVICE
AutoCAD 2008 – Carlson 2008 Software Instructions 5/09

Drawing a Tank in Carlson Including Calculating Cut and Fill

This instruction sheet will guide you through drawing a manure tank and calculating volumes of cut and fill. Carlson modules are displayed as **{Civil-Design}**, main menus are displayed as **[Points]**, and submenus and menu commands are displayed as **<Edit Points>**. A table on Page 6 will assist in the data entry and organization. These values are displayed as ***__**.

Create a grid of the existing surface using – Creating 3D Surfaces
Contour the site using the appropriate instruction sheet ( )

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.

1) **{Civil - Design}** → **[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) **{Civil - Design}** → **[View]** → **<Layer Control>**
   a. Create a new layer by clicking the "**New Layer**" button
   b. Type in a layer name of "***Circle***"
   c. Create layers for "t**ank**", "**tank-cut**", and "**tank-fill**"
      i. Attribute the layers as you like
   d. Click "**OK**" when done
3) Add the circle drawn above to the "***Circle***" layer

DRAWING THE TANK POLYLINE

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

4) Make "***tank***" the active layer
5) Draw a polygon: **{AutoCAD Module}** → **[Create]** → **<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 "***Circle***" layer
7) Set the finished floor elevation: **{Civil - Design}** → **[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 polyline representing the bottom of excavation: **{Civil - Design}** → **[3D Data]** → <3D Polyline Utilities> → **<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 polylines on the "***tank-cut***" layer.
11) Run the Design Pad Template to create the cut: **{Civil - Design}** → **[Surface]** → **<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. Slope Projection Perpendicular To…: **Pad Polyline**
    d. Design Slope Format: **Ratio**
    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 Cut**
13) Click "**OK**" when done
14) Select the excavation polyline on the "***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) Type "**N**" and then "**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 "**Enter**" to not trim contours
26) Press "**N**" and then "**Enter**" not 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 "***tank-cut***" and "***PAD – Tank Cut***"
28) Offset the tank polygon to create the top of the wall on the inside of the tank: **{Civil - Design}** → **[3D Data]** → **<3D Polyline Utilities>** → **<Offset 3D Polyline>**
29) Press "**Enter**" for the Interval offset method
    a. Enter "**0.1**" and press "**Enter**" for the horizontal offset
    b. Enter the **tank height** and press "**Enter**" for the vertical offset (height of wall) ***A**
    c. Select the **tank polyline** and **click outside** the tank to offset the line and create the top of the wall

d. Press "**Enter**" to end the routine

30) Offset the tank polygon to create the top of the wall on the outside of the tank: **{Civil - Design}** → **[3D Data]** → <3D Polyline Utilities> → **<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 0.83) ***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
31) Offset the tank polygon to create a fill line on the outside of the tank: **{Civil - Design}** → **[3D Data]** → <3D Polyline Utilities> → **<Offset 3D Polyline>**
32) Press "**Enter**" for the Interval offset method
   a. Enter the "**5"** and press "**Enter**" for the horizontal offset (creates a ~4' level section around tank before the fill slopes off)
   b. 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**
   c. 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.
   d. Press "**Enter**" to end the routine
33) Place the outermost polyline on the "***tank-fill***" layer.
34) Turn on the existing contours if they are off.
35) **Freeze** the "***tank***" layer
36) Run the Design Pad Template to draw the fill around the tank: **{Civil - Design}** → **[Surface]** → **<Design Pad Template>**
37) Select the following in the "**Design Pad Template**" box:
   a. Source of Surface Model: **Surface File**
   b. Slope Direction from Closed Polylines: **Outside**
   c. Slope Projection Perpendicular To…: **Pad Polyline**
   d. Design Slope Format: **Ratio**
   e. Use Sloped Pad Design: **Checked**
      i. If the fill will be at the same elevation around the tank, do no 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. $Slope = \frac{3'}{FillDiameter} \times 100$ ***N,O**
         (1) *Example*: Tank diameter = 90', fill pad diameter = 90 (tank) + 5.0 (0.67 (wall) + 5.33 (level)) + 6.0 = 100'
   f. Round Exterior Corners: **Checked**
   g. Draw Side Slope Polylines: **Checked**
   h. Side Polyline Spacing: **25**
   i. Cut/Fill Factors: **1.000**

j. Pad Layer Name: **PAD – Tank Fill**

38) Click "**OK**" when done
39) **Click** the fill polyline on the "***tank-fill***" layer
40) In the "**Select the Slope Target Surface**" dialog box that appears, navigate to and **double-click** the existing ground grid file to use
41) Enter the fill slope ratio: **3**
42) Enter the cut slope ratio: **0.75** or flatter
43) 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.**
44) 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.**
45) Type "**N**" and "**Enter**" to calculate the earth work volumes
46) Type "**N**" then "**Enter**" to not adjust and redesign the pad
47) Press "**Y**" and then "**Enter**" to trim the contours
48) Press "**Y**" and then "**Enter**" to retain the trimmed contours
49) Press "**N**" and then "**Enter**" to leave the trimmed contours on their current layer
50) 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
51) Press "**N**" and then "**Enter**" to not join the existing and proposed contours
52) 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.

53) Turn on the "**COGO – tank**" layer
54) Draw the fill polyline against the tank using the polyline representing the inner edge of the fill pad: **{Civil - Design}** → **[3D Data]** → <3D Polyline Utilities> → **<Offset 3D Polyline>**
    a. Press "**Enter**" for the Interval offset method
    b. Enter the "**6.0 - thickness of the wall in feet"** and press "**Enter**" for the horizontal offset (typically 5.33 or 5.17) ***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
55) **{Civil - Design}** → **[View]** → **<Isolate Layers>**
    a. Select the "***Tank***" and the "***PAD – Tank Fill***" layers and press "**Enter**" when done
    b. Press "**Enter**" to not retain points
56) **{Civil - Design}** → **[Surface]** → **<Make 3D Grid File>**
    a. Name the grid file with the notation of "*Tank Fill*" and pres "**Save"**
    b. Select the following in the "**Make 3D Grid File**" box:
        i. Source data: **Screen Entities**
        ii. Range of Elevations/Values to Process: **Low – 1.00; High – 20000.00**

iii. Modeling Method: **Triangulation**
iv. Triangulation Mode: **Auto Detect**
v. Grid Position/Resolution – Set Grid Position…: **From Another Grid File**
vi. Click "**OK**" when done

c. In the "**Grid File to get position from**" dialog box that appears, navigate to and **double-click** the existing ground grid file to use
d. Type "**ALL**" and then "**Enter**" to select all objects.
e. Press "**Enter**" to complete the routine.

57) Restore the frozen layers: **{Civil - Design}** → **[View]** → **<Restore Layers>**
58) Create a proposed grid: **{Civil - Design}** → **[Surface]** → **<Modify Grid File>** → **<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. Type "**R**" and then "**Enter**" to replace overlapped features in the original grid file with those from the proposed grid file.
f. Select the **outermost** "***PAD – Tank Fill***" polyline for the inclusion line and press "**Enter**"
g. Press "**Enter**" for no exclusion lines
h. **Name the merged grid** with a name like "*Smith Proposed Fill*" and press "**Save**" when done
59) Turn on the "***PAD - Tank Cut****"* layer
60) Calculate the fill volume: **{Civil - Design}** → **[Surface]** → **<Volumes by Grid Surface>** →**<Two Surface Volumes>**
a. **Select the outer edge** of the outermost *PAD* (*Cut and/or 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 [redacted] 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

61) Freeze the "***PAD - Tank Cut****"* layer

Data Input Table for MD-CS-48 - Drawing a Tank in Carlson 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)		29b, 30c	
B	Tank Diameter	ft				
C	Tank Radius	ft	½ diameter		1b, 5d	
D	Wall Thickness	ft	Design Dependent (typ. 0.67, 0.83, or 1.0)		30b, 54b	
E	Finished Floor Elev.	ft				
F	Top of Tank Elev.	ft	Finished Floor + Tank Height	E + A	7a	
G	Excavation Elev.	ft	Finished Floor – 1.0' (typ.)	E – 1.0'	18	
H	Wall Height Above Ground	ft	Site Dependent (min. 0.5')			
I	Max Fill Height	ft	Tank Height – Wall Height Above Ground	A – H	32b	
J	Max Fill Elevation	ft	Finished Floor Elevation + Max Fill Height	E + I		
K	Elevation Difference Across Tank (Existing)	ft	Use the existing contours to find the elevation difference		37a	
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		37a	
M	Minimum Elevation of Fill Against Tank	ft	Max Fill Elev. – Proposed Elev. Difference	J – L	43	
N	Fill Pad Diameter	ft	Tank Diameter + 10' (typ.)	B + 10.0'	37a	
O	Fill Pad Slope	ft	Proposed Fill Elevation Difference / Fill Pad Diameter	L / N	37a	