

Circular Concrete Tank

Overview: Layout of a Circular concrete tank involves placing the tank in the plan view, creating surfaces for the subgrade excavation, drainfill material, and earthen backfill material. Profiles can be created from these surfaces and placed into CAD in combination with a block that is based on the Midwest Plan Service TR-9 circular concrete tank design. A surveyed site with a surface model covering the footprint is needed. The NRCS Circular Tank tool is used.

Software: AutoCAD Civil 3D 2018, NRCS C3D 2018 Customization & Template

Notation Method	Button to Press	<i>Displayed Text</i>	Icon	<u>Action</u>	{Text to Enter}	<u>Menu Item</u> ...
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Prerequisite

Follow the instructions for creating *Original Ground Contours*.

Circular Concrete Tank

Place the Circular Concrete tank into the project

- 1) Click *NRCS ... NRCS Storage Ponds... Circular Tank...*
- 2) Input the Interior dimensions. The useable storage is displayed at the bottom.
- 3) Input the Exterior dimensions based on the MWPS TR-9 or other design. (Note: the CAD block of the tank cross section uses a 2' offset from cut slope to the footing.)

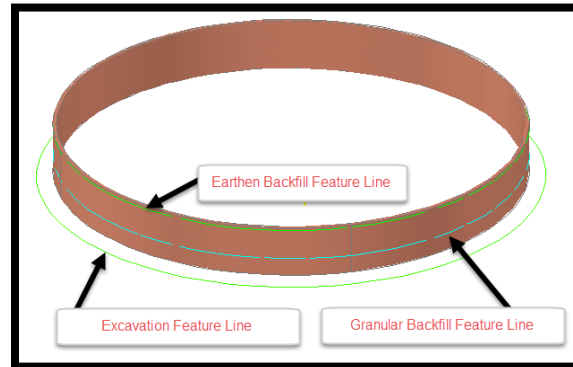
Exterior Dimensions based on MWPS TR9 – NRCS Drawing IA1630			
Tank Depth	Wall thickness	Footing Overhang	Footing Thickness
8'	8"	12"	0.833'
10'	8"	14"	1'
12'	10"	14"	1'
14'	10"	15"	1'

- 4) Input the Elevation for the tank floor.
- 5) If you are inserting more than one tank option, rename the *AcadGroup Name*. (e.g. CircularTank2, etc)
- 6) Pulldown *Earthen Backfill Feature Line Style = Finished Grade Feature Line*
- 7) Pulldown *Granular Backfill Feature Line Style = Core Trench Feature Line*
- 8) Pulldown *Excavation Feature Line Style = Structure Excavation Feature Line*
- 9) Pulldown *Alignment Label Set Style = Major (Perp) Minor Geometry (100 and 50)*
- 10) Pulldown *Text style = 001xB_Notation(B)*
- 11) Click Insert into Drawing.
- 12) Select the point in CAD for the center of the tank.


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13) This will create objects in CAD as a group:

- a. 3D Solid for the tank wall only (W.Plan.Conc.New_);
- b. C3D Feature lines in Sites: for the edge of the subgrade excavation cutslope (Concrete Tank - Excavation), for the estimated top of drain backfill (Concrete Tank - Granular Backfill), and for the estimated top of earthen backfill (Concrete Tank - Earthen Backfill);
- c. Alignment for creating 2 cross sections; and
- d. Text listing the tank size, elevations, and dimensions.



Adjust the location and elevation of the tank

- 14) Click *NRCS ... NRCS Storage Ponds... Turn On:Selection by Group*  to enable the object group selection.
- 15) Turn off the OsnapZ elevation setting: Type *Osnapz* Press Enter, Type *1* Press Enter (This allows you to use Osnaps without changing the Elevation of the objects.)
- 16) To move the tank layout:
- a. Select any line of the tank layout, Click the **Move icon**.
 - b. Click any location as a reference point for moving the tank.
 - c. Click the new location of the center.
 - a. Move your cursor to obtain the new rotation angle and click.
- 17) To change the elevation of the tank:
- a. Select any line of the group,
 - b. Right-Click *Basic Modify... Move...*
 - c. Input {D} Enter to use a displacement option
 - d. Input {0,0,2} Enter to raise the tank by 2'

Note: The label does not get updated to the new elevation.

18) Re-enable elevation moving: Type *Osnapz* Press Enter, Type *0* Press Enter
These steps can also be used after the grading has been applied.

Subgrade Excavation

Create the excavation grading to the ground surface.

19) *Home... Create Design... Grading... Grading Creating Tools...*

20) Click **Set the Grading Group** .

21) Set the Site to *Concrete Tank - Excavation*. Click

22) Click **Create Grading Group**

23) Input a Grading Group Name E.g. {Excavation} Click

24) Click **Set the Target Surface** . Select *Ognd*. Click

25) Pulldown the **Select a Grading Criteria** to *Slope or Grade to Surface (Cut and Fill)*

26) Click **Create Grading**. 

27) Select the outer storage Pond line. Click outside of the tank excavation feature line.

28) Apply to entire length? Input *Y* Press Enter

- 29) Slope or grade? Input S Press Enter.
- 30) Cut Slope? Input 1.5. Press Enter
- 31) Slope or grade? Input S Press Enter.
- 32) Fill Slope? Input 3. Press Enter
- 33) Press ESC to exit the command
- 34) *Home... Create Design... Grading... Create Grading Infill*
- 35) Click inside of the tank excavation feature line. Press Enter.
- 36) Close the Grading Creation Toolbar

Create the Excavation surface



- 37) Select the slope grading.
 - 38) Right-click *Properties...*
 - 39) In the Information section set the *Styles = _Grading (3Green)*
 - 40) From the Ribbon: *Grading...Modify... Grading Group Properties...*
 - 41) On the Information Tab checkmark *Automatic Surface Creation*.
 - 42) Type = *TIN Surface*. Set the Name to *Excavation*. Style = *Grid Magneta 5x5*.
 - 43) Click . Click . Click .
- Note: This grading display is controlled by C.Topo.Stex.Feat & 1.C3D.Grad.Gree layers.

Combine the Excavation surface with the original ground

- 44) *Toolspace> Prospector... Right-click Surfaces... Create Surface...*
- 45) Input a name for the Combined surface. E.g. {Ognd w Excavation}
- 46) Select a “No-smoothing” display style. Click . Click
- 47) *Toolspace> Prospector... Surfaces... Ognd w Excavation ... Definition...Right-click Edits... Paste Surface...*
- 48) Select the *Ognd* Surface. Click .
- 49) *Toolspace> Prospector... Surfaces... Ognd w Excavation ... Definition...Right-click Edits... Paste Surface...*
- 50) Select the *Excavation* Surface. Click . (Note: the Excavation surface must be pasted in **after** the Ground surface.)



Computing the Cut and Fill Volume for the Subgrade Excavation

Compute earthwork volumes


- 51) Click *Analyze... Volumes and Materials... Volumes Dashboard* 
- 52) In Panorama click **Create new Volume Surface** 
- 53) Input a Name E.g. {V Excavation - Ognd}
- 54) Set the Style = *_<off>* Click
- 55) Set the Base Surface = *Ognd*. Set the Comparison Surface = *Excavation*
- 56) Click
- 57) Volume surfaces get created and Quantities will be displayed in the Dashboard.
- 58) Save the drawing.

You can go back and modify the location, rotation, or elevation of the grading to improve the volumes and layout. Be sure to select the Tank selection group and NOT the grading

or surface. The outer grading will update automatically. Sometimes the Infill needs to be added back in to the grading if the group is moved too far.

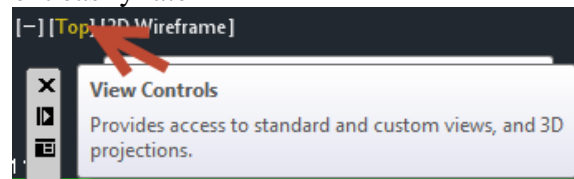
- 59) In Composite Volumes click **Re-compute Volumes** to make sure they are current.
- 60) Use **Generate Cut/Fill Report**  to create a report. It can be saved or information can be copied from the report into Word or Excel Document
- 61) In Civil 3D click dismiss  to close the **Volumes Dashboard** Panorama.

To track depths of the Excavation.

- 62) Use *Home...Palettes* ▾.. *Coordinate Tracker*  on the *V Excavation – Ogn*d surface to see the Cut or Fill depths.


Create a Named View in order to find this Alignment easily later

- 63) Zoom to a full view of the alignment that you just created.
- 64) Click the View Controls... *View Manager... New...*
- 65) Inter a View Name. E.g {Tank Plan View}
- 66) On the View Properties tab Uncheckmark *Save layer snapshot with view.*
- 67) Click . Click .




Creating Profile Views of the tank

Name the 2 tank Profile alignments.

- 68) *NRCS ... NRCS Storage Ponds... Turn Off:Selection by Group* .
 - 69) Select one alignment created with the tank.
 - 70) If the direction of the alignment is incorrect, use *Alignment...Modify* ▾ ... *Reverse Direction* and Click .
 - 71) *Alignment... Modify...Alignment Properties...*
 - 72) On the Information tab set the Name, E.g. {Tank S to N}
 - 73) On the Station Control Tab the Reference point and beginning station can be set.
 - 74) Click . Press ESC.
- Repeat for the 2nd alignment. E.g. {Tank W to E }

Extract profiles to a profile view

- 75) Decide on the horizontal scale that you want for the Profile Views and set the drawing annotation Scale. . Based on the horizontal scale, here is the reach length that fits into a viewport. 140' (1"=10'), 280' (1"=20'), 560' (1"=40'), 700' (1"=50')
- 76) Click *Home... Create Design... Profile... Create Surface Profile ...*
- 77) Pull down the alignment to *Tank profile S to N.*
- 78) The Station range *To sample* can be used to limit the length of the alignment profiled.
- 79) Use Ctrl + Click to select the multiple surfaces to be profiled. E.g *Ogn*d & *Excavation*
- 80) Click to apply the process to the selected surfaces

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- 81) In the Profile list pulldown the style to match the type of surface E.g. { Ognd } & { Structure Excavation }
- 82) Click Draw in Profile View
- 83) Set the Profile View style to the Horizontal/Vertical scaling desired. E.g. {A40Hx5V}
Click Next
- 84) Select User Specified Range and input values for starting and stopping. Click Next
- 85) Select User Specified view height and input values for grid elevations. Click Next
- 86) Click Create Profile View
- 87) Click a location in the drawing for the profile to appear.

Create a Named View in order to find this Profile View easily later

- 88) Zoom to a full view of the profile view that you just created.
- 89) Click the View Controls... *View Manager... New...*
- 90) Input a View Name. E.g {Tank S to N - Profile }
- 91) On the View Properties tab Uncheckmark *Save layer snapshot with view.*
- 92) Click OK. Click OK.

Repeat the Profile Extraction and Named View creation for the 2nd alignment.

- 93) To rotate the cross section alignment lines:
 - a. Select the alignment.
 - b. Right-Click *Basic Modify... Rotate...*
 - c. Snap to the center of the tank.
 - d. Move your cursor to obtain the new rotation angle and click.

Placing the 3D solid tank (wall only) into a profile view. (Optional)

- 94) Use *Home...Profiles & Sections Views...Profile View... Project Objects to Profile View...*
 - 95) Click the tank 3d solid object. Press Enter.
 - 96) Click the profile view where you want it to appear
 - 97) Click OK. The tank walls will appear in the profile view.
- Note: The label for the tank is the midpoint elevation and can be deleted.

Labeling Elevations on an Object in the Profile

- 98) Click *Annotate... Labels & Tables... Add Labels... Profile View... Station Elevation..*
- 99) Click the Profile View.
- 100) Osnap to the top of tank wall to set the station to be labeled.
- 101) Osnap to the top of tank wall to set the elevation to be labeled.
- 102) When done Press Enter
- 103) Save the drawing.




Earthen & Granular Backfill

- 104) Review the Profiles and decide a planned elevation of the top of earthen backfill and granular backfill at each quadrant of the tank.


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- 105) Click the View Controls... *Custom Model Views.. Tank Plan View* to zoom to the Plan View.
- 106) Use View...Model Viewports... Viewport Configuration... *Three:Left* to switch to 3 views
- 107) Leave one as a Plan view, orbit another to an Isometric view using the View Cube, and pan the 3rd to a Profile view.



Apply the correct top of earthen backfill elevations to the feature lines.

- 108) *NRCS ... NRCS Storage Ponds... Turn Off:Selection by Group* .
- 109) Select the backfill feature lines, tank, profile views, and the alignments.
- 110) Right Click... *Isolate Objects ... Isolate Selected Objects*
- 111) Select the earthen backfill feature line
- 112) Right click in the drawing area. Click *Edit Elevations*.
- 113) In the Grading Elevation Editor double click elevations to edit them.
- 114) Use **Insert Elevation Point**  to add grade breaks.
- 115) When done editing the elevations, click the checkmark  to dismiss the editor.

Create the earthen backfill grading to the ground w/ excavation surface.

- 116) *Home... Create Design... Grading... Grading Creating Tools...*
- 117) Click **Set the Grading Group** .
- 118) Set the *Site* to *Concrete Tank – Earthen Backfill*. Click **OK**
- 119) Click **Create Grading Group** 
- 120) Input a Grading Group Name E.g. {Earthen Backfill} Click **OK**
- 121) Click **OK**
- 122) Click **Set the Target Surface** . Select *Ognd w Excavation*. Click **OK**

Note: Varying grading criteria might be used depending on the site.

- 123) Pulldown the *Grading Criteria* to *Distance and Grade*
- 124) Click **Create Grading**.
- 125) Select the Granular Backfill feature line. Click outside of the backfill feature line.
- 126) Apply to entire length? Input {Y} Press Enter
- 127) Distance? Input {10} Press Enter.
- 128) Grade? Input {0}. Press Enter
- 129) Pulldown the **Select a Grading Criteria**  to *Slope or Grade to Surface (Fill)*
- 130) Click **Create Grading**. 
- 131) Select the outer grading line. Click outside of the line.
- 132) Apply to entire length? Input Y Press Enter
- 133) Slope or grade? Input {S} Press Enter.
- 134) Fill Slope? Input {3}. Press Enter
- 135) Press ESC to exit the command
- 136) Close the Grading Creation Toolbar

Create the Earthen Backfill surface

- 137) Select each outer grading individually.

- 138) Right-click *Properties...*
- 139) In the Information section set the *Styles = Finished Grading*
- 140) Repeat for the other backfill gradings.
- 141) Select the outer grading.
- 142) From the Ribbon: *Grading...Modify... Grading Group Properties...*
- 143) On the Information Tab checkmark *Automatic Surface Creation.*
- 144) *Type = TIN Surface.* Set the Name to *Earthen Backfill.*
- 145) *Style = Grid Magneta 5x5.*
- 146) Click Ok. Click Ok. Click Ok.

Note: This grading display is controlled by C.Topo.Fini.Feat, C.Topo.Fini.Ctch & C.Topo.Fini.Slop layers.

Extract backfill profiles to a profile view



- 147) Click *Home... Create Design... Profile... Create Surface Profile ...*
- 148) Pulldown the alignment to *Tank profile S to N.*
- 149) Use Click to select the backfill surface. E.g *Earthen Backfill*
- 150) Click [Add>>] to apply the process to the selected surfaces
- 151) In the Profile list pulldown the style for backfillE.g. { Finished Ground }
- 152) Click [Ok]

Repeat for the alignment of the 2nd profile view.


- 153) Save the drawing.



Granular backfill.

Apply the correct top of granular backfill elevations to the feature lines.

- 154) Select the drainfill feature line
- 155) Right click Click *Edit Elevations.*
- 156) In the Grading Elevation Editor double click elevations to edit them.
- 157) Use **Insert Elevation Point**  to add grade breaks.
- 158) When done editing the elevations, click the checkmark  to dismiss the editor.

Create the granular backfill grading to the ground w/ excavation surface.



- 159) *Home... Create Design... Grading... Grading Creating Tools...*
- 160) Click **Set the Grading Group** .
- 161) Set the *Site* to *Circular Tank – Granular Backfill.* Click [OK]
- 162) Click **Create Grading Group** 
- 163) Input a Grading Group Name E.g. {Granular Backfill} Click [OK]
- 164) Click [OK]
- 165) Click **Set the Target Surface** . Select *Ognd w Excavation.* Click [OK]
- 166) Pulldown the *Grading Criteria* to *Distance and Grade*
- 167) Click **Create Grading.**
- 168) Select the Granular Backfill feature line. Click outside of the backfill feature line.
- 169) Apply to entire length? Input { Y } Press Enter
- 170) Distance? Input { 3 } Press Enter.

- 171) Grade? Input {0}. Press Enter
- 172) Pulldown the **Select a Grading Criteria**  to *Slope or Grade to Surface (Fill)*
- 173) Click **Create Grading.** 
- 174) Select the outer grading line. Click outside of the line.
- 175) Apply to entire length? Input Y Press Enter
- 176) Slope or grade? Input {S} Press Enter.
- 177) Fill Slope? Input {1.5}. Press Enter
- 178) Press ESC to exit the command
- 179) Close the Grading Creation Toolbar

Create the Granular Backfill surface

- 180) Select each granular backfill grading.
 - 181) Right-click *Properties...*
 - 182) In the Information section set the *Styles = _Grading (4Cyan)*
 - 183) Select the outermost grading.
 - 184) *Grading...Modify... Grading Group Properties...*
 - 185) On the Information Tab checkmark *Automatic Surface Creation.*
 - 186) *Type = TIN Surface.* Set the Name to *Granular Backfill.*
 - 187) *Style = Grid Magneta 5x5.*
 - 188) Click Ok. Click Ok. Click Ok.
- Note: This grading display is controlled by C.Topo.Cort.Feat & 1.C3D.Grad.Cyan layers.

Extract backfill profiles to a profile view




- 189) Click *Home... Create Design... Profile... Create Surface Profile ...*
- 190) Pulldown the alignment to *Tank profile S to N.*
- 191) Use Click to select the backfill surface. E.g *Granular Backfill*
- 192) Click  to apply the process to the selected surfaces
- 193) In the Profile list pulldown the style for backfill E.g. {Core Trench}
- 194) Click 

Repeat for the alignment of the 2nd profile view.


- 195) Right click in the drawing... click *Isolate Objects... End Object Isolation...*
- 196) Save the drawing.

Computing the Backfill Volumes

Compute volumes

- 197) Click *Analyze... Volumes and Materials... Volumes Dashboard* 
- 198) In Panorama click **Create new Volume Surface** 
- 199) Input a Name E.g. { V Granular Backfill - Ognd w Excavation }
- 200) Set the Style = *_<off>* Click 
- 201) Set the Base Surface = *Ognd w Excavation.* Set the Comparison Surface = *Granular Backfill*

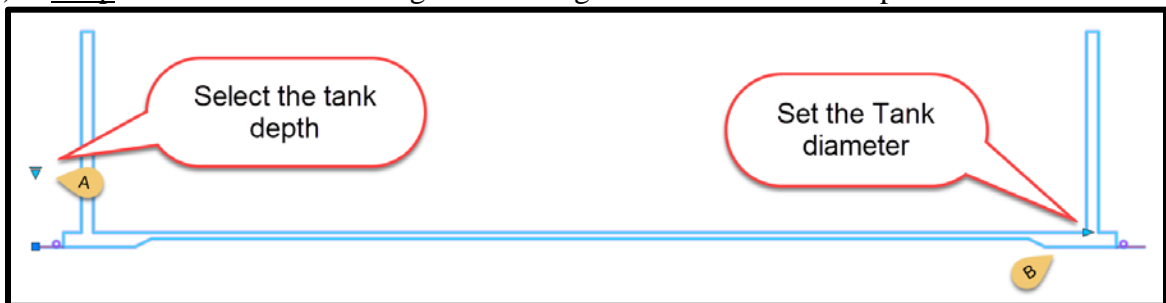
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- 202) Click **OK**
- 203) In Panorama click **Create new Volume Surface** 
- 204) Input a Name E.g. { V Earthen Backfill - Ognd w Excavation }
- 205) Set the Style = *off* > Click **OK**
- 206) Set the Base Surface = *Ognd w Excavation*. Set the Comparison Surface = *Earthen Backfill*
- 207) Click **OK**
- 208) Volume surfaces get created and Quantities will be displayed in the Dashboard.
Note: the Earthen total fill volume will need to be reduced by the Granular fill volume.
- 209) Dismiss the Volumes dashboard when done.
- 210) Use *View...Model Viewports... Viewport Configuration... Single* to reset the model view.

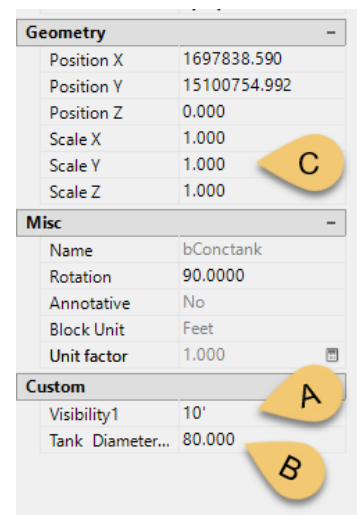
Profile Views & Tank blocks

Placing a Tank Section block into the Profiles

- 211) Tool Palette>NRCS 11x17B... Click *11x17 Symbols b... bConctankDynamic...*
- 212) Snap the block to the left edge of the subgrade excavation in the profile.



- 213) Select the tank block.
- 214) Click to select the tank depth (See A) [8, 10, 12, or 14]
- 215) Right-click *Properties...*
- 216) In the Custom section input the *Tank Diameter* (See B) Press Enter
- 217) In the Geometry section set the *Y scale* value (See C) as the Horizontal divided by Vertical scale for this profile view. (40/5=8) {8} Press Enter. Press ESC.






- 218) If the depth or diameter need to be changed, set the Scale Y back to 1 in order enable the dynamic block sizing options.
Note: These tank details do not update if the Profile View scale, etc is changed.
- 219) Save the drawing.

Summary of Workflow

1. Create a project that has the Original Ground surface created.
2. Determine the storage requirements of the concrete tank.
3. Examine the elevations of the site and determine the size and elevations of the tank.
4. Place a concrete tank into CAD at the proposed elevation using the Circular Tank layout tool. Feature lines for the subgrade excavation grade break, estimated drainfill, and estimated earthfill also get placed into CAD
5. Project the slopes from the subgrade excavation edge to original ground and create the surface for the tank subgrade excavation.
6. Calculate excavation volume by comparing Original ground to Excavation.
7. Extract profile views showing the original ground, tank, and excavation.
8. Merge the Excavation surface with the Original Ground surface.
9. Adjust elevations of the earthfill and granular backfill line based on the profiles.
10. Project the slopes to the merged OG/excavation surface for creating the earthfill.
11. Extract the Earthen backfill surface into the 2 profile views.
12. Project the slopes from the top of granular backfill to the merged OG/excavation surface and create the granular backfill surface.
13. Extract the Granular backfill surfaces into the 2 profile views.
14. Calculate granular backfill volume by comparing OG/Excavation merged to Drain surface.
15. Calculate earthfill volume by comparing OG/Excavation merged to Earthfill surface and then subtracting out the granular backfill volume.
16. Place the Tank cross section block into the profile views.

Tools in the NRCS Ribbon:

NRCS ... NRCS Storage Ponds...

- *Manage Object Groupings* . Allows you to manage and modify objects within a group.
- *Turn Off: Selection by Group* . When Selection by Group is turned off, objects in a group are selected individually.
- *Turn On: Selection by Group* . When Selection by Group is turned on, all objects in a group are selected just by selecting one object.