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 2016, NRCS C3D 2016 Customization & Template

<table>
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<tr>
<th>Notation Method</th>
<th>Button to Press</th>
<th>Displayed Text Icon</th>
<th>Action</th>
<th>{Text to Enter}</th>
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Prerequisite
Follow the instructions for creating Original Ground Contours.

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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.)
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.

Exterior Dimensions based on MWPS TR9 – NRCS Drawing IA1630

<table>
<thead>
<tr>
<th>Tank Depth</th>
<th>Wall thickness</th>
<th>Footing Overhang</th>
<th>Footing Thickness</th>
</tr>
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<tbody>
<tr>
<td>8’</td>
<td>8”</td>
<td>12”</td>
<td>0.833’</td>
</tr>
<tr>
<td>10’</td>
<td>8”</td>
<td>14”</td>
<td>1’</td>
</tr>
<tr>
<td>12’</td>
<td>10”</td>
<td>14”</td>
<td>1’</td>
</tr>
<tr>
<td>14’</td>
<td>10”</td>
<td>15”</td>
<td>1’</td>
</tr>
</tbody>
</table>
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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 OK
22) Click Create Grading Group
23) Input a Grading Group Name E.g. {Excavation} Click OK
24) Click Set the Target Surface . Select Ognd. Click OK
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
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29) Slope or grade? Input S Press Enter.
31) Slope or grade? Input S 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 Ok. Click Ok. Click Ok.
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 Ok. Click Ok.
47) Toolspace> Prospector… Surfaces… Ognd w Excavation… Definition… Right-click Edits… Paste Surface…
48) Select the Ognd Surface. Click Ok.
49) Toolspace> Prospector… Surfaces… Ognd w Excavation… Definition… Right-click Edits… Paste Surface…
50) Select the Excavation Surface. Click Ok. (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 Ok.
55) Set the Base Surface = Ognd. Set the Comparison Surface = Excavation
56) Click Ok.
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.
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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**.

To track depths of the Excavation.
62) Use **Home…Palettes ▼ Coordinate Tracker** on the V Excavation – Ognd 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) **Input** a View Name. E.g {Tank Plan View}
66) On the View Properties tab **Uncheckmark Save layer snapshot with view**.
67) **Click OK. Click OK**.

**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 OK**.
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 OK. 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 Ognd & Excavation
80) **Click Add>>** to apply the process to the selected surfaces.
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.
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 **Style** = *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.


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.**
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171) Grade? Input \{0\}. Press Enter
172) Pulldown the Select a Grading Criteria \(\text{Slope}\) 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 Add>> to apply the process to the selected surfaces
193) In the Profile list pulldown the style for backfill E.g. \{Core Trench\}
194) Click Ok.
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 \(\text{✓}\)
198) In Panorama click Create new Volume Surface \(\text{✓}\)
199) Input a Name E.g. \{ V Granular Backfill - Ognd w Excavation\}
200) Set the Style = \_<off>\. Click Ok.
201) Set the Base Surface = Ognd w Excavation. Set the Comparison Surface = Granular Backfill.
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... bConctank100x10...
Note: Use the tank block based on correct wall height. (All 4 tank depths are 100’ diameter. The diameter will be increased or decreased later.)

212)  Snap the block to the left edge of the subgrade excavation in the profile.

213)  Select the tank block.

214)  Right-click Properties...

215)  In the Geometry section set the Y scale value as the Horizontal scale divided by the Vertical scale for this profile view. (40/5=8) {8} Press Enter. Press ESC.

216)  Click Home... Modify... Explode

217)  Select the tank block. Press Enter

218)  Click Home... Modify... Stretch

219)  Use a Crossing Window (Right to Left) around the right half of the tank and right cut slope. To remove other objects from the selection (such as the grid and profile lines) press {r} Press Enter. Then select objects to remove.

220)  Press Enter

221)  Click anywhere for a stretch base point.

222)  Using the change in diameter relative to the 100’ tank, input the amount to stretch the tank. E.g. {@-40,0} would reduce the tank to a 60’ diameter. Press Enter
Note: These tank details do not update if the Profile View scale, etc is changed.

223)  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.