

Instructions

14' x 16' x 6' Concrete Block Tank without Lid Standard Detail

General Description

This standard detail is a water tight tank that may be used as a component (Waste Storage Facility – practice code 313) of a Waste Management System for livestock producers, or as an Irrigation Reservoir (practice code 436), or as water storage for a Watering Facility (practice code 614). The tank capacity is approximately 10,000 gallons (1,344 cubic feet). The tank may be installed above ground, or set partially in the ground. It is structurally sound enough to set within the ground with just enough sticking out to keep runoff from entering it (it has no lid). This is discouraged as additional features such as a full fencing with security gate or other provisions to prevent persons or livestock from falling into it are absolutely required as safety features. There is no standard detail version of this tank with a cast in place lid. The size of the structure may be required for a particular site and application. Rather than set the tank in the ground, the planner/designer is encouraged to consider a sump and pump configuration to move fluids to and from the above ground tank. The inlets and outlets can be located at any elevation in the tank that meets the planned use, e.g. it could be a 4 inch diameter gated outlet at the bottom of the tank for use as an outlet for liquid manure. The outlet could be to a Livestock Pipeline (practice code 516) and trough, or to an Irrigation System. It is quite possible that the system it is a part of needs no penetrations of the walls or bottom at all (if a Pumping Plant – practice code 533, is used to unload the tank and it is loaded from above, e.g. a roof gutter downspout). The important item with the inlets and outlets is to locate them where they will not require cutting of the reinforcing steel and at elevations which make the system work.

Design Criteria and Specifics

The structure meets the requirements of the NRCS Waste Storage Facility (practice code 313), which specifies the designer use ACI 318, the design methodology for nearly all steel reinforced concrete. The specifics of a site in which any standard design is applied are variable. To make the tank as universally useable as possible the structural analysis was done with worst case loading scenario as input into the ACI 318 procedure. The loading used was for a buried to the brim empty tank back filled to the top of the wall with a surcharge equal to two feet of saturated clay. Though the condition isn't likely to exist for an open topped tank, using the loading ensures the design meets applicable standards. Other backfill material (well drained sands and gravels for example) will result in lower forces on the tank walls. The design is probably conservative for most applications. The investment of time for exact minimal materials for each installation is not justified by even the greatest possible savings in cost. When this tank is part of an NRCS planned system, the siting is within the expressed limits, and it is built as drawn, NRCS will stand behind the design for all backfill conditions with the explicit exception of situations where building or heavy vehicle traffic is within 18 ft (5.5 meters) of it.

Quantities

1. 8"X8"X16" Concrete Blocks - 329 each
2. 3,000 psi Concrete (for floor pad and cast-in-place bond beam) - 8.0 cubic yards
3. 3,000 psi Grout/Mortar - 5.2 cubic yards
4. Total rebar weight (40ksi) - 2,504 pounds

5. 2" dia. PVC Schedule 80 Nipple - 1 each (may vary in number and size with the system configuration).
6. Excavation and Fill (Native Soils) - To be determined; the amount of earthwork is dependent on how deep the tank is set in the ground.
7. Select Backfill - To be determined as it is site specific.

Limitations

The structure should not be installed where there are additional loadings like building foundations or heavy traffic within 18 ft (5.5 meters) of the walls or where the tank full of liquid represents a surcharge on other structures that may not have been designed to support the additional loading. The foundation the tank sits on is very important. The planning site investigation should give a feel for the material that must be excavated when the tank is to be set in the ground. Even above ground sites should have the foundation evaluated. Soft, poorly consolidated soils may allow differential settling. As a result the tank could tip or suffer from cracking. Settling alone could cause problems for the pipes that will run into and out of it. Setting the tank on a base composed of different materials, e.g. rock outcrop adjacent to compressible soil, is an invitation for cracking. This is a larger tank and the greater span makes it more susceptible to cracking from differential settlement than the smaller standard detail tanks. Do not plan or install this tank on legs, stilts, or in any other position elevated above the ground as the seismic analysis did not address that condition.

Site Specific Additions

The three sheets of the drawings should be clear enough for any contractor or proficient, "do it yourselfer," to construct. Any change in the inlet and outlet to the tank needs to be carried on the drawings including the quantities and through to the engineer's estimate. The drawing can be modified with white out and a good pen. Those proficient with and having access to AutoCadd may opt to modify the standard detail digitally, even to importing the model into digital topographic surfaces and creating a single .dwg file for the project. Tank burial depths can be drawn on sections A and B (left side of tank sections, Sheet 1); show the ground line and draw dimension arrows to communicate the depth. The same information would show up on the profile sheet for the system (especially necessary for gravity systems). Appropriate notes should be added to Section A of the drawings. Compute the excavation and backfill quantities. Add them to the quantities and engineer's estimate. You should be using local costs. Be sure to amend the title block to include the sheet number (corresponding to the detail's position in the final set of construction drawings), the cooperater name and the Soil & Water Conservation District we are working with.

When the tank is used for animal waste storage, outside water must be either excluded, or discharge from the 25 year 24 hour storm maintained within the structure. Storage of rainwater is not recommended as for our climates it would likely eliminate about 30% of the effective waste storage volume. The outside water can be excluded by a roof over the livestock facility and over the tank itself. The roof does not need to be elaborate as long as there is no chance that people will be walking on it. If there is a doubt, fence them out! Again, special safety additions are in order when the site installation has the structure more than 2 ft in the ground. Consider a sump and pump for loading the tank rather than setting it in the ground. The quantities table will need to be amended to include the amounts of excavation and backfill of native soils, any select backfill required, fencing, roofing, etc..

At the total project level, a plan view sheet showing the location of the tank in relation to existing site features is required. The cover sheet showing the information in National Engineering Manual parts 503 and 541 are required. Give recipient of the design enough information to make layout of the components easy. Show a bench mark (with a symbol, matching narrative description, and the elevation of the bench mark(s)) somewhere in the design so elevations of features can be set (including this tank) Excavation, fill or site preparation and other installation special requirements needed should be covered in the project construction notes. Seeding requirements for disturbed areas should be part of the project design (either Critical Area Planting, code 342; or Conservation Cover, practice code 327 depending on anticipated ease or difficulty to establish vegetation). A profile drawing is recommended for communicating required tank connection to other system components, especially if the system is gravity driven. **Safety MUST be considered in the design process.** Even partially buried open topped tanks should have clear fencing requirements restricting all access to the immediate vicinity of the tank. The totally above ground open topped tank does not have that concern. For animal waste storage, warning signs are in order.

Construction

During construction it is important to make sure that the tank is placed on well compacted material. Site preparation for tank installation involves excavating the site to the called for elevation and dimensions. In addition placement of select backfill and compaction should be monitored to ensure adequate tank foundation. Construction notes on the drawings give specifics.

The concrete and steel in the floor and the bond beam along the rim of the tank carry significant loads. The construction notes on the drawing tell what the builder must do. The reason it needs to be done in that manner is that concrete has the greatest strength when made with only the minimum water needed for hydration (concrete does not dry, it sets), i.e. it is strongest when it is a stiff mix. Unfortunately concrete placement and consolidation are easiest when the material is very soupy (high slump). Unless the proper slump is met, concrete mix will not meet strength requirements. There are additives available that will make the concrete easy to place without adding water, mention them to the contractor. It's important for NRCS to be there before and when concrete is poured. We make sure the surface is properly prepared, the forms are sound and to grade, the steel reinforcement has been placed as shown on the drawings, materials used are not damaged or of the wrong size, and that the forms are to the required dimensions. Please note that the mark 3 bars (bars tying the pad to the walls) must be positioned correctly before the floor pad is poured. The vertical bars from the floor pad should be very securely tied into position. The force of concrete being placed can cause shifting of the steel. It's difficult to correct and causes problems with the block alignment. **It is an OSHA requirement that any protruding steel be secured to prevent the possibility of impalement. Let us have no tragedies on our projects.** Finally, be sure that provisions are made for the moist cure called for by the construction notes.

We should be visiting the site to check on the block laying. Check to make sure that horizontal rebar is placed in every block layer. All cells need to be filled with grout. The timing of our visit is dependent on the type of grouting used. Grout can be placed in the concrete blocks as the wall is going up, or it can be added after the block laying by using "high lift," grouting

technique. The uppermost two courses should be grouted separately due to the bond beam steel being tied into the cells of those units. The high lift method has all block laid with reinforcing in place. When block laying is complete a hole is broken into the sides of the bottom most cells of the concrete blocks. A chain or bar is used to knock "mortar scab," away from the interior of the cells. Busted up material is removed from the hole in the bottom of the column of cells. The cells are thoroughly wetted prior to placing grout. The grout is introduced into the top and vibrated down until it begins to run out of the hole in the bottom. A temporary form is then placed against the hole in the bottom. More grout is introduced and consolidated in the hole until the column of cells is completely filled. Grout is a very high slump (7 or more inches, i.e. nearly liquid) of a 3 parts sand to 1 part Portland cement mix. A 3/8" mortar/plaster facing shall be applied on the interior walls for tank liquid-tightness. There are products available for sealing the interior of tanks such as this. If an owner/builder requests such a substitution, ask for a submittal that includes the directions for use, then review and if the design approver is in concurrence that it is adequate, allow the change. The important point is that the interior needs to be watertight so that rebar isn't subjected to increased rates of corrosion because of constant wetness.

Only after concrete is cured and the plumbing connections into and out of tank have been made, should backfill around the exterior of the tank be allowed. Native soils may be used though gravel is recommended because of shrink/swell possibilities. See sheet 1 of the standard detail for typical installation and backfill. Check that the backfill lifts and compaction are as called for on the construction notes, especially for foundation work..

Concrete is to be prevented from drying for at least 7 days after pouring. Exposed surfaces need to be kept continuously moist for the entire period. Moisture can be maintained by sprinkling, wet rags covered with plastic, wet organic matter (leaves) or flooding. Formed surfaces need to be thoroughly wetted immediately after forms are removed and should be kept wet until patching and repairs are completed. Not removing the forms for the week will reduce water loss. Curing compounds can be used. Water or covering shall be applied in such a way that the concrete surface is not eroded or otherwise damaged. The high water content of masonry grout and the partial absorption of this water by the masonry units will generally provide adequate moisture for grout curing.

Operation and Maintenance: The O & M plan for the component needs to include at least the design volume, the expected frequency of tank emptying and procedures, periodic maintenance and tank cleaning requirements, and instructions to contact NRCS if there are problems.

References: ACI 318 – Concrete Strength Design; Waste Storage Facility conservation practice standard - Code 313; Engineering Field Manual (National Engineering Handbook part 650 Chapter 17 – Materials), Section IV of the USDA NRCS Pacific Islands Area FOTG; USDA NRCS Agricultural Waste Management Field Handbook (National Engineering Handbook part 651 Chapter 10 – Component Design).