Instructions
Water Catchment Tank with Internal Overflow and Drain Standard Detail

General Description

This standard detail is a riser pipe within a tank that functions as an overflow. Using bell and spigot non-glued ASTM D 3034 pipe allows the vertical stem to be removed resulting in a rapid draining of the water from the tank. The use of tanks for collection of rain water is a sound solution to the resource concern of insufficient fresh water. Water collected can be used for irrigation, livestock watering, or as wash water for animal waste systems.

Uncontrolled watershed into a tank will often result in "over topping." Though overflow of the tank will not usually jeopardize the structural integrity of the tank, the over flow should be addressed to prevent unacceptably wet conditions in the vicinity of the tank. If the tank is set on gravel or soil, deterioration (erosion) of the foundation could result from water flowing around the tank. If there are structures such as roads or buildings immediately downstream from the tank, over flow could create problems with them.

Any over flow feature should be sized to pass the expected amount and rate of runoff from the connected watershed. Roofs and other runoff collection features are usually relatively small. Estimation of discharge should be done based on the short duration high intensity rainfalls as opposed to the runoff curve number techniques used for watersheds greater than 1 acre. Overflow should be conveyed to locations away from the tank.

Tanks may need to be emptied from time to time to remove algae, accumulated debris, attend to seepage or leaks, and to repair associated fixtures (penetrations, hose bibs, inlet lines, etc.). The time to empty a tank can be lengthy if the only functional outlet is a hose bibb that might pass 10 gallons per minute. The 6' x 6' x 6' standard detail concrete masonry unit tank holds about 1,600 gallons. Emptying time would be greater than 2 hours. The 10' x 10' tank (4,400 gallons) would take more than 7 hours.

This overflow/drain configuration is one of several techniques available. It has been successfully constructed and has performed for a significant period of time. The tank empties rapidly when the vertical piece of pipe is pulled from the socket. The discharge velocity when draining will impose pressure flow on the outlet pipe. The discharge velocity will be high and if energy is not dissipated, will result in erosion at the outlet.

Design Criteria and Specifics

The appurtenance shown is governed by the Underground Outlet conservation practice standard, code 620. Obviously the riser cannot be perforated else the storage function of the water catchment would be compromised. Overflow capacity is determined using the weir flow formula $Q=CLH^{3/2}$ with C as 3.3 for a sharp crested weir, L as the circumference of the pipe in ft, and H as the distance between the allowable high level within the tank and the crest of the riser pipe in ft. For 4 inches (0.33 ft) of head, the capacity of overflow is 0.98 ft^3/sec. Hydrology from the roof or catchment surface should be computed independently in accordance with the type of operation and the requirements of the practice standard for Roof Runoff Structure, code 558. Gutter and downspouts for any roofs involved should also be designed for the specific site. See the spread sheets available on this USDA NRCS PIA engineering sub-web. For larger tanks and larger roofs, increasing the overflow pipe from 6 inch diameter to 8 inch diameter may be prudent.

Quantities

1. 90 degree elbow, 6 inch diameter ASTM D 3034 bell and spigot PVC pipe utilizing elastomeric gasket – 1 each
2. 6” diameter ASTM D 3034 pipe riser, 5 ft 10 inches – 1 each
3. 8”x8”x16” bond beam concrete masonry units – 23 each
4. 3,000 psi Grout/Mortar - 2 cubic feet
5. 3,000 psi concrete (floor of energy dissipater) – 0.7 cubic yards
6. Total #4 rebar length (40ksi) - 132 feet
7. 1" dia. schedule 40 PVC pipe (drain for outlet works) – 8”
8. Trench excavation and fill (Native Soils) - To be Determined – Site specific
9. Select Backfill - To be determined.

Limitations

The riser overflow outlet is an appurtenance to the NRCS PIA standard concrete masonry unit tanks when used as storage for harvested rainfall.

Site Specific Additions

The single sheet should be used in conjunction with one of the USDA NRCS PIA standard details for concrete masonry unit (cmu) tanks. For any individual site a plan view of the outlet pipe and energy dissipater is essential. A profile of the outlet line is highly recommended. Certainly survey and even some cursory geology is prudent when selecting the outlet location. Quantities for a particular installation can be computed once data has been gathered and decisions have been made. The biggest variable when bringing this standard detail to a specific site is the amount of trenching and the length of pipe.

Construction

The most important construction concern for this feature is to ensure the pipe under the tank has been installed to the required elevations and that the backfill of the trench beneath the tank is done with attention to detail. For the short distance involved the builder might consider just backfilling the horizontal pipe immediately beneath the tank with concrete as a single pour with the floor. Preparation for the pouring of the tank floor around the riser pipe socket as a minimum would be making sure the pipe is clean. A concrete compatible adhesive is recommended for use about the exterior of the socket immediately before placement of the concrete. This will improve the bond between the concrete and the pipe.

The outlet energy dissipater is standard concrete masonry unit construction. The floor of it could be cast at the same time the concrete and steel in the floor and the bond beam around the top of the tank tying the side walls into the lid of the tank carry significant loads. The construction notes on the drawing tell what the builder must do. The reason the concrete needs to be stiff (low slump) is that concrete has the greatest strength when made with only the minimum water needed for hydration (concrete does not dry, it sets). Unfortunately concrete placement and consolidation are easiest when the material is very soupy (high slump). This is especially relevant to the floor and lid of the structure. 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 in 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 roof 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 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 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 an adequate replacement (longevity, toxicity if tank is for water supply), allow the change.

For in ground installation, only after concrete is cured, including the lid, 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 outside the immediate vicinity of the box, again for safety a recommended maximum is 2 ft. Experience has taught that well compacted high shrink swell clay as backfill next to a structure can create loadings beyond those used in the design. Check that the backfill lifts and compaction are as called for on the construction notes.

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. 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 651Chapter 10 – Component Design).