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Manure storage structures for small dairies

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Abstract

Kansas environmental regulations require dairy producers with more than 300 animal units (215 mature cows at 1,400 lb, or equivalent weight) to be able to store the manure scraped from freestalls, lots, alleys, and holding pens for 120 days. Many dairies are smaller than the size requiring mandatory registration. However, some are considered a potential environmental problem because of their location near streams or waterways and/or their management and application of manure and may require registration. The intent of the regulations is that manure be stored from December to March to avoid applying it onto frozen ground. Most dairies consider these prime months for manure application, but these are the least desirable from an environmental perspective. Manure applied to frozen ground is not absorbed, and, therefore, the nutrient value of the manure drains from the fields when snow melts or early spring rains are heavy. Three types of storage structures are described.; Dairy Day, 1994, Kansas State University, Manhattan, KS, 1994;

Keywords

Dairy Day, 1994; Kansas Agricultural Experiment Station contribution; no. 95-141-S; Report of progress (Kansas Agricultural Experiment Station); 716; Manure; Storage; Structures; Concrete

MANURE STORAGE STRUCTURES FOR SMALL DAIRIES

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Summary

Kansas environmental regulations require dairy producers with more than 300 animal units (215 mature cows at 1,400 lb, or equivalent weight) to be able to store the manure scraped from freestalls, lots, alleys, and holding pens for 120 days. Many dairies are smaller than the size requiring mandatory registration. However, some are considered a potential environmental problem because of their location near streams or waterways and/or their management and application of manure and may require registration. The intent of the regulations is that manure be stored from December to March to avoid applying it onto frozen ground. Most dairies consider these prime months for manure application, but these are the least desirable from an environmental perspective. Manure applied to frozen ground is not absorbed, and, therefore, the nutrient value of the manure drains from the fields when snow melts or early spring rains are heavy. Three types of storage structures are described.

(Key Words: Manure, Storage, Structures, Concrete.)

Introduction

Most dairies are able to store manure less than a week. In many cases, the manure manages the dairy producer rather than the dairy producer managing the manure. Storage structures enable the dairy producer to manage the manure and apply it immediately prior to working tillable land. Thus, maximum benefit from the nutrients in the manure is obtained. Data in Midwest Plan Service handbooks shows little decrease in nutrient value when manure is stored in nonanaerobic conditions. Storage structures also allow dairy producers more time for managing their dairy herd, because the manure is stored for extended periods. Manure is hauled and applied in several concentrated time periods during the year, rather than daily or weekly.

A dairy cow produces 80 lb of manure per 1,000 lb of live weight per day. The density of the manure is approximately 60 lb/cf. Therefore, the storage space required for a 1,000 lb cow is equal to 1.33 cf/day or 160 cf per 120 days of storage. A 1,400 lb cow produces 225 cf of manure during 120 days.

Fresh manure is about 87% moisture. Only a portion of it is actually scraped into the storage basin. The manure in the basin will be about 80% moisture, which reduces the total storage space required. For design purposes, the storage basin should be sized based on a minimum of 1 cf/1,000 lb/day.

Types of Storage Structures

Producers using straw, newspaper, or shavings may find the moisture content to be lower than 80%, but additional storage is required for the bedding. Straw bedding can be stacked on a flat slab with a 24 to 48 in high retaining wall on two or three sides.

Many options are available for storing manure and are being considered and used by Kansas dairies. Some include mechanical separators, concrete structures and slabs, or storage lagoons and ponds. Other dairies are considering rotational grazing as an option to

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reduce the manure storage requirements. These are not all of the possible methods for handling the manure, and additional structures are needed to handle the milk house or parlor effluent and runoff from confinement lots during rainfall.

The manure can be handled as a solid or a slurry. Most small dairies seem to favor the solid manure handling systems, because they already have the necessary equipment. Slurry systems required a manure tank wagon and agitator and often utilize aboveground storage structures. Dairy farms located in areas of high water table may have no alternative but to use aboveground storage structures to avoid ground water pollution problems.

Belowground concrete structures are common for handling the manure as a solid. These include a concrete sloped ramp and concrete wall structure (CSRCW), a concrete level bottom with concrete wall structure (CLBCW), and a concrete bottom with earthen side wall structure (CBES). Attached are drawings showing three examples of different storage structures. For design purposes, the assumptions for these drawings are as follows: 50 cow milking herd, average weight of 1,400 lbs or total live weight of 70,000 lbs, replacement and dry cows housed in another location, storage depth limited to 4 ft, 6 in of freeboard maintained, a full 120-day storage provided, and manure handled as a solid at 80% moisture content.

Option 1. Concrete Sloped Ramp and Concrete Wall Structure (CSRCW)

Figure 1 shows a schematic of a CSRCW storage structure. It is 32 ft wide, 106 ft long, and 4 ft deep. (Note: width and length can be adjusted to fit the site.) The slope of the entrance ramp may range from 5 to 10% (the one in Figure 1 is 8%. The length of the ramp is 50 ft, with the remaining 56 ft being a level bottom. A perforated drain pipe allows the liquid portion, or rain water, to drain from the CSRCW and to discharge into a holding pond, lagoon, sediment basin, or designed grass filter. A minimum of 20 in is allowed around the pipe to provide access for cleaning debris away from it. The pipe should be protected by a 3/4 in wire mesh screen or plastic-coated screen. The minimum area of the screen is 36 sq ft, or sized at 4 ft by 9 ft. The screen keeps the solids away from the pipe and prevents plugging. The screen should be mounted on a steel tubing frame. The frame should be removable to allow access to the pipe. Some producers are opting to place a wall through the middle, such that two, 16-ft wide tanks are created. This allows the manure to be scraped into one side, while the other side is drying or being cleaned. With this system, two perforated pipes are required, but they can drain into a common pipe upon exiting the basin. For a 50-cow dairy, a 6 in perforated pipe is adequate. The openings in the pipe should provide a minimum of 6 sq in of opening per vertical foot of pipe.

Option 2. Concrete Level Bottom with Concrete Wall Structure (CLBCW)

Figure 2 is an example of a CLBCW storage structure. This structure is 32 ft wide, 80 ft long, and 4 ft deep. Access into the CLBCW is through a 12 ft (minimum) width opening or gate on one end of the structure. The opening should be wide enough to allow a manure spreader and tractor to back into the CLBCW during unloading. A modification of the CLBCW uses the perforated drain pipe as shown in Figure 1 to drain away the liquid. In some cases, the wire screen is attached to the gate to allow the liquid to drain through the gate into a sediment basin. Another modification to this design is the use of timber planks, which slide into the notches on each side of the opening. A 1-in gap between the planks or perforated pipe is used to drain away the liquids. The disadvantage of planks is that their removal is necessary in order to empty the structure. Once the top plank is removed, manure can overflow onto the others before they are removed, and the structure is completely emptied.

Option 3. Concrete Bottom with Earthen Side Wall Structure (CBES)

A more economical structure for some dairies, the CBES, is shown in Figure 3. The top dimensions of the CBES are 52 ft by 116 ft, which do not include the top berm. The structure's depth is 4 ft, with end wall slopes of 12:1

and sidewall slopes of 4:1. This structure provides 12 to 16 ft wide concrete ramps on each end of the structure and a concrete bottom. The side walls are earthen with a slope of 3:1 to 5:1. End walls are 10:1 to 20:1. Concrete is placed on the side walls where manure is scraped into the CBES. A perforated pipe is used to drain the liquid from the structure. The pipe should be protected by a 4 ft by 4 ft wire mesh screen.

All of the structures should have a minimum of a 20 ft apron at the entrance. This provides a hard surface for equipment to park on while emptying the structure. The structures in Figures 1 and 2 can be expanded in 30- to 45-day storage increments, but that in Figure 3 is not readily expandable. Producers should use a consultant when seeking a permit from KDHE and consult with their milk inspector prior to initiating construction. Inspectors may wish to see other drainage problems corrected.

Conclusion

Kansas dairies that are below the required animal units for registration should be able to store their manure for a minimum of 30 days and preferably 60 or more. This would enable them to better manage the manure by less frequent application to land, thus avoiding environmentally sensitive times of the year. Properly managing the manure produced on a dairy farm and being concerned about the environment are ways to avoid additional regulations. Insensitivity to the environment, or the potential of nutrients leaving a field, could result in more stringent regulations and monitoring in the future.

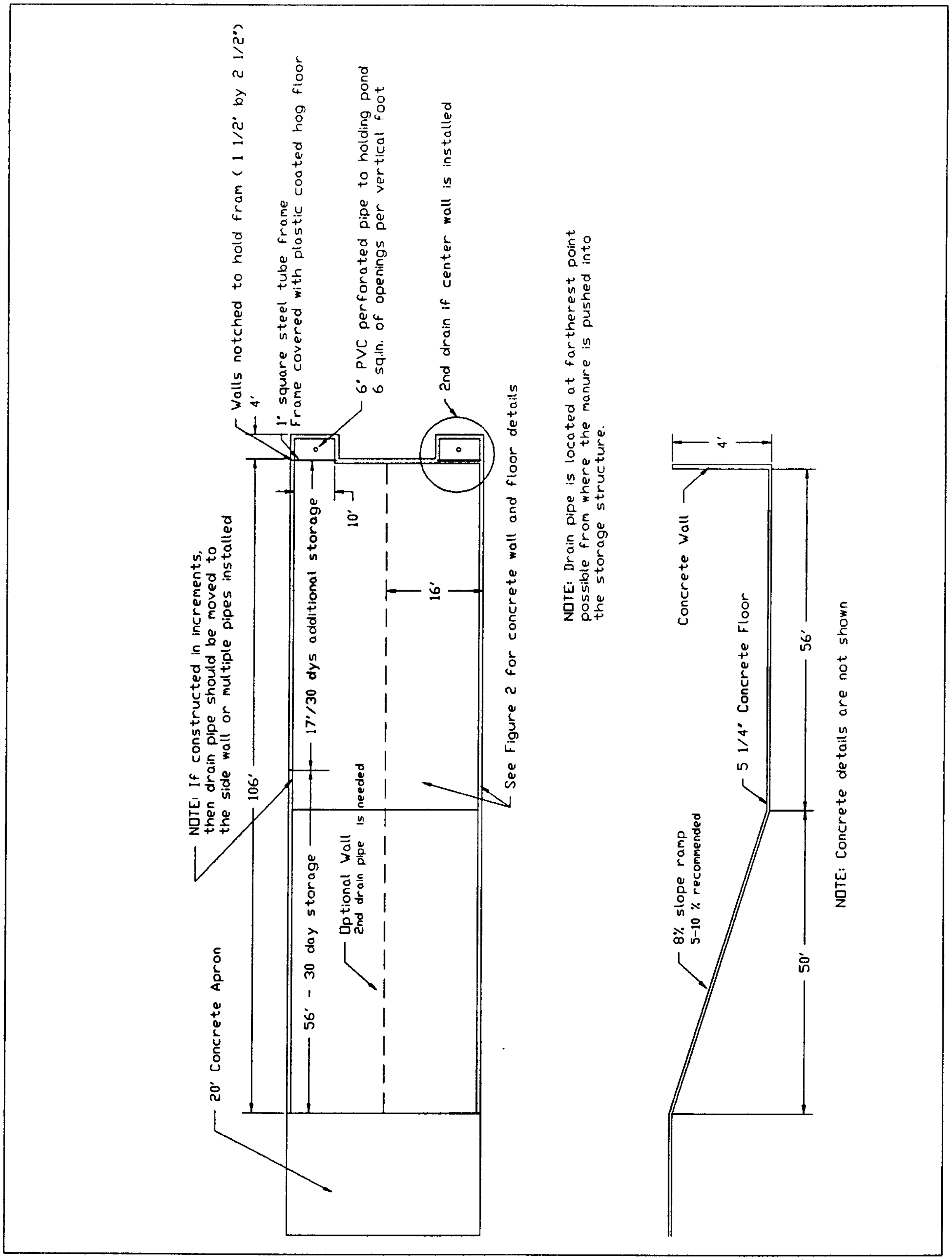

Figure 1. Concrete Sloping Ramp and Concrete Bottom Storage Structure

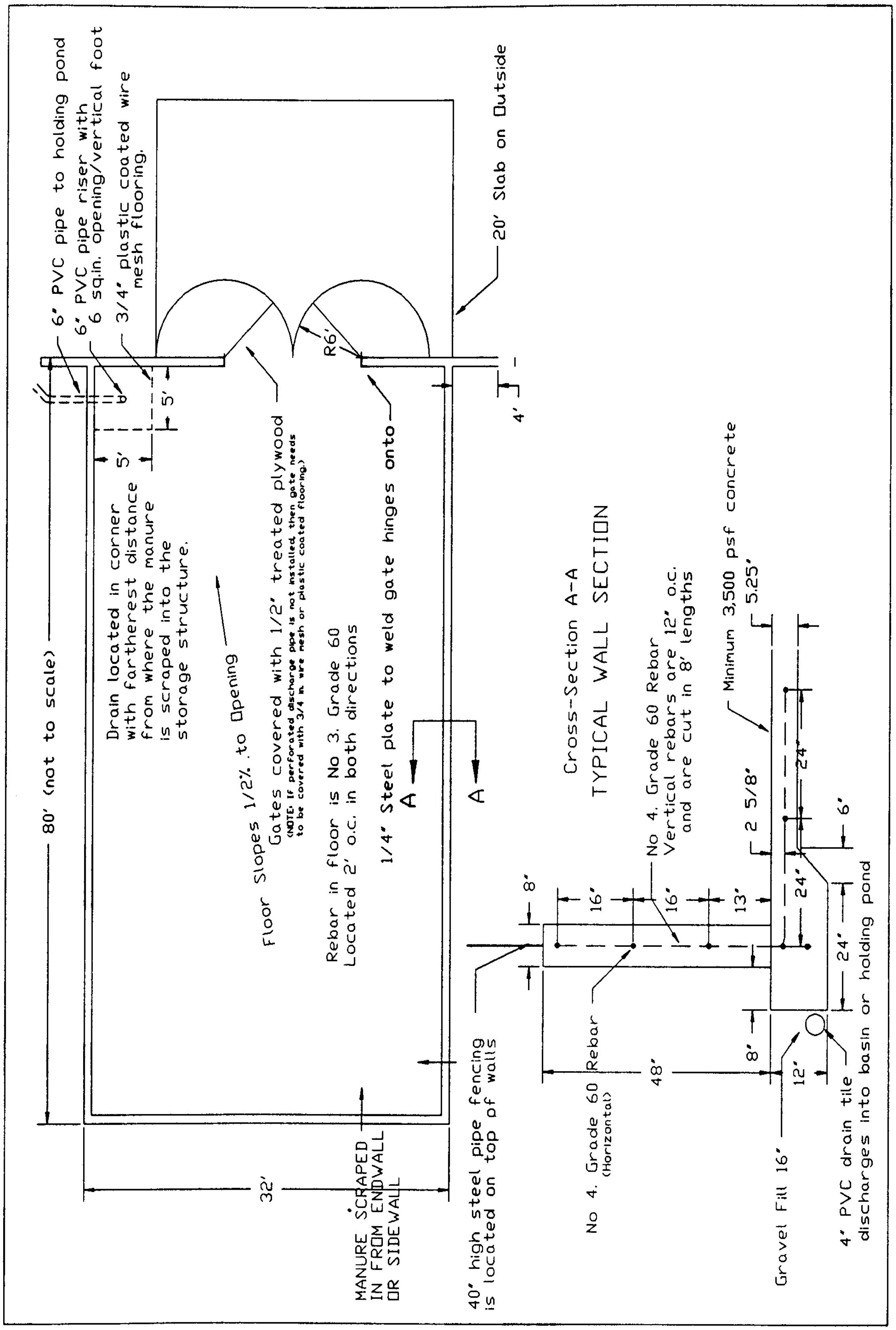

Figure 2. Concrete Level Bottom and Concrete Sidewall Structure

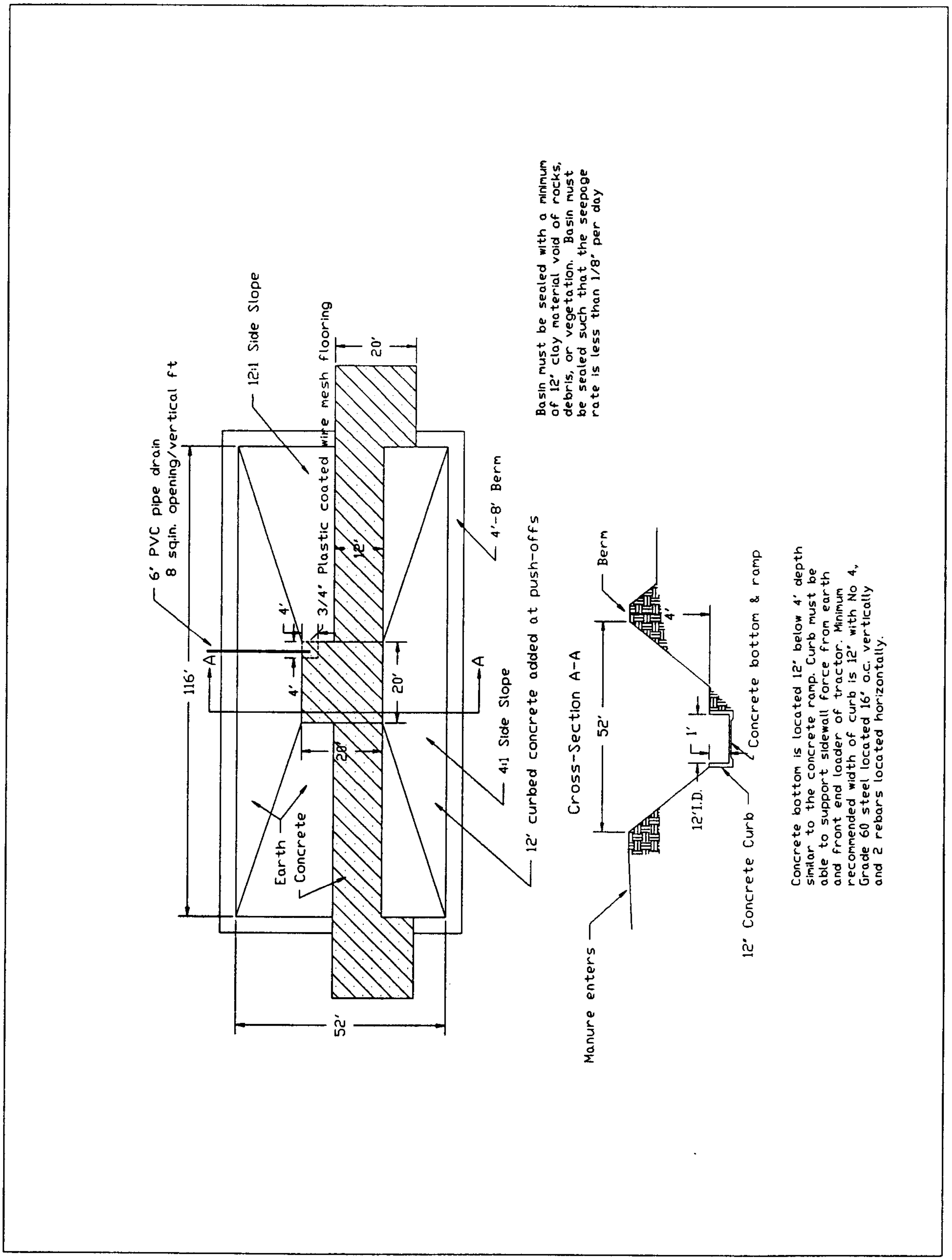

Figure 3. Concrete Bottom and Earthened Sidewalls with Concrete Entrance Ramps