SOIL CONSERVATION SERVICE

WASTE STORAGE STRUCTURE

Definition

A fabricated structure for temporary storage of animal wastes or other organic agricultural wastes.

Scope

This standard establishes the minimum acceptable requirements for planning, designing, constructing, and operating and maintaining waste storage structures, including waste storage tanks and waste stacking facilities. It does not apply to waste storage ponds (425) or to waste treatment lagoons (359), even though they may have paved ramps or linings. Storage tanks are used for liquid and slurry wastes and may be: (1) open or covered, (2) within or outside an enclosed housing, or (3) beneath slotted floors. Stacking facilities are used for wastes that behave as a solid and may be open or roofed.

Purpose

To temporarily store liquid or solid wastes as part of a pollution-control or energy-utilization system to conserve nutrients and energy and to protect the environment.

Conditions Where Practice Applies

This practice applies where: (1) the structure is a component of an overall plan prepared according to SCS standard for waste management systems (312); (2) temporary storage is needed for organic wastes generated by agricultural production or processing; (3) the structure can be located without polluting air or water resources; and (4) soils and topography are suitable for construction of the structure.

Wastes from sources such as canneries require special design considerations due to the content and volume of the leachate.

Plans and Specifications

General

This practice shall not be installed until an overall waste management system (312) has been considered and the essential components determined.

Planning Data

The need for storage or storage area will vary according to site location, the operational or management plan, the size of herd or number of livestock involved, availability of fields for waste utilization, nearness to streams, and depth to bedrock or groundwater. Most livestock operations will require one or more sites where wastes can be stored or placed during: (1) winter days when severe weather prevents daily spreading, (2) periods in the spring during snowmelt when the potential for pollution is too great to spread wastes, (3) periods when soil conditions prevent spreading and, (4) periods during the growing season when fields are not available for spreading.

Terms and Definitions

Temporary Storage - Storage of the manure will be on a temporary basis; the manure will be periodically removed from the structure. All manure storage structures are considered permanent with a minimum anticipated service life of 10 years.

Short-term Storage - This term relates to operations where the landowner desires to spread the waste on a daily basis. However, due to various reasons including the potential for water pollution, it is necessary or desirable to restrict the field application of manure for periods of time ranging from one day to several days at any one time throughout the year. The designed storage volume for any given year will be the volume anticipated for 30 to 100 days.

Long-term Storage - This term relates to operations where the landowner regularly stores the manure throughout the year. Field application of the waste will be performed periodically, usually once or twice per year. The designed storage volume will be the volume anticipated for 100 to 365 days.

Manure Storage Platform - refers to a storage area with a liquid tight concrete floor constructed on the ground surface or partially below the existing ground surface. These storage platforms may utilize sidewalls of concrete or treated timber to better contain the wastes. This type of storage is applicable to solid or semi-solid manure. The storage area is emptied by using front-end type loaders for loading spreaders. Manure storage platforms are applicable to systems for either short or long term storage.

The two types of manure storage platforms used are: (1) essentially liquid-tight wall construction, and (2) acceptable drainage system to convey the precipitation runoff and leachates to a desirable location. See table 2 for complete definitions.

Acceptable Drainage System - Liquids from storage structures shall be conveyed in a liquid-tight conveyance system to an outlet which directs the outflow away from any well and does not allow the outflow to reach a floodway or flood plain in a concentrated or uncontrolled manner. The pollution potential of the liquid must be reduced to an acceptable level prior to entering floodways or flood plains by using: (1) designed filter strips that are at least 2 ft (0.61 m) above bedrock or groundwater and have a minimum of 25 percent of the soil material (by weight) which passes the #200 sieve, or (2) an existing buffer area which reduces the pollution potential equivalent to the filter strip design due to the flow of liquids over the ground surface and through

various types of ground cover. The soil shall be at least 2 ft (0.61 m) above bedrock or groundwater and have at least 25 percent finer than the #200 sieve. The reduction shall be predicted by using the Agricultural Research Service (ARS) model and SCS procedures. All foreign runoff (runoff from other than the storage structure) shall be diverted downstream from the buffer area, or (3) holding pond to store the liquids until they can be removed. This pond must meet the criteria in waste storage ponds (425).

Groundwater - means the higher of the elevation to which the soil is saturated as observed as a free water surface in an unlined hole, or the elevation to which the soil has been seasonally or periodically saturated as indicated by soil color patterns throughout the soil profile.

Storage Tanks or Structures - storage structures with liquid-tight floors and sidewalls constructed to contain solid, semi-solid or liquid manure. These may be either above or below the ground surface.

Liquid-tight Concrete floor - refers to reinforced concrete which has construction features that prohibit water flow through the construction or control joints. See Structural Design section, page 10, item 5, for criteria on required reinforcement, joints and sealers for slabs.

Location

The following factors must be considered in selecting a site for waste storage structures: proximity of the structure to the source of wastes, access to other facilities, ease of loading and emptying wastes, appropriate health regulations, and direction of prevailing winds to minimize odors.

Manure storage structures shall be located to minimize the pollution potential to lakes, streams and other surface waters caused by spills due to neglect, oversight or system malfunction.

The minimum distance from any well or reservoir to a manure storage facility shall be 100 ft (30.5 m). Storage facilities shall be located to eliminate the possibility of drainage or over-spill from flowing from the structure toward any well. The ground elevation at the well shall be higher than the ground elevation at the storage structure or the topography shaped to direct any drainage or over-spill further away from the well. Other requirements for separation from bedrock and/or groundwater are given in table 2.

Reception pits, hoppers, tanks, and transfer pipes from which manure is pumped to storage facilities shall conform to the requirements in the standard for waste transfer (358).

Soil and foundation

Soil profiles obtained by borings or backhoe test pits shall be made to an elevation at least 3 ft (0.9 m) below the anticipated floor elevation of the storage structure unless bedrock is encountered above this depth.

Environmental protection

All disturbed land surfaces shall be vegetated or otherwise stabilized to control soil erosion. The location, layout, and design of the facilities should be compatible with the surrounding landscape. Existing landforms and vegetation, along with land shaping and vegetative plantings, shall be considered to minimize an adverse impact upon visual resources.

Facilities must be constructed in areas and in a manner which prevents flooding. Waste storage structures shall not be placed in floodways or channels that convey water. Structures located on the flood fringe must meet the requirements of Wisconsin Administrative Code NR116 and be protected from inundation by a 100-year frequency regional flood. The floor of all structures shall be a minimum of 2 ft (0.6 m) above the 100-year frequency flood elevation.

Loading and unloading

Adequate maneuvering space shall be provided for operating loading and unloading equipment. Pushoffs must be structurally sound and must be provided with railings, safety bars, or other devices to prevent humans, animals, and equipment from falling into the facility. Provisions shall be made for removing liquids that accumulate from solid wastes or from precipitation.

Disposal facilities

Equipment shall be available for removing wastes from the storage structure, processing them for energy, or applying them to the land at the locations, times, and rates shown in the overall management plan.

Service life and durability

Planning, design, and construction shall insure that the structure is sound and of durable materials commensurate with the anticipated service life, initial and replacement costs, maintenance and operation costs, and safety and environmental considerations.

Guidance in evaluating the service life of various materials is given below. The materials indicated meet the requirements of this standard. The service life of materials not shown shall be based on performance data.

Service life	Material 1/
Short (minimum of 10-yr)	Wood; masonry, including concrete staves; flexible membranes; glass fiber reinforced plastics/resins; steel coated with zinc, epoxy, vinyl, and asphalt; reinforced concrete.
Medium (minimum of 20-yr)	Reinforced concrete; glass-fused steel.
Long (minimum of 50-yr)	Reinforced concrete.

1/ The durability and estimated life of reinforced concrete is a function of the design criteria and the quality of the concrete. A key aspect affecting durability is corrosion of the reinforcement, which is directly related to cracking (design stress), and the reinforcement cover. The quality levels of reinforced concrete are discussed under "Structural Design," "Design Criteria."

Design Criteria

Service life

The structure shall be planned, designed, and installed to provide a minimum service life of 10 years.

Size

The volume of the structure shall be large enough to store accumulated wastes, bedding, wash water, and needed dilution water for the maximum period during which such wastes cannot be processed for energy or be applied to the land because of operational restrictions, weather, or crops. Provisions should be made to insure that outside runoff does not flow into the structure. If suitable provisions cannot be made, however, the anticipated volume of runoff likely to enter the structure must be included in the required volume. The design capacity must allow for any direct rainfall and snow. An allowance of at least 6 in (15.2 cm) shall be provided in the bottom of the storage tank to accommodate materials that are not removed during emptying. A minimum of 6 in (15.2 cm) shall be provided for freeboard. Tables 3 through 8 or reliable local information can be used in determining the quantity of waste production.

The volume of storage required will depend upon the operation and maintenance plan. Adequate storage shall be provided to provide for that period of time between emptying which requires the largest volume of storage. This minimum volume may be increased by an amount up to 10 percent to allow for unforseen weather or operational conditions. Items to consider when determining the frequency for emptying the storage unit are (1) the individual management involved, (2) soils, (3) land slope of fields to be used for waste utilization (spreading area),

(4) nearness of spreading area to lakes, streams, rivers and (5) other environmental considerations. The minimum storage period used for determining the required volume is 30 days.

Tables 3 and 4 provide data for determining the manure production for various animals. Table 5 provides straw bedding volumes.

The volume of wash water should be determined by actual measurement or careful estimation of water used for the operation. Table 6 may also be used.

Liquids, which include precipitation runoff and manure leachates, from storage tanks and manure storage platforms must be retained within the storage facility, collected in a holding pond, or applied to filter strips or buffers which reduce the pollution potential before the liquids enter into drainage ditches, streams or lakes. If precipitation runoff collects in manure storage facilities which store solid or semi-solid manure, it is usually necessary to pump or drain the runoff water from the loading ramp and corners if loader-spreader manure handling equipment will be used to remove the waste. Vertical-slotted openings, holes in the walls, and vertical-slotted openings in conjunction with pipe outlets or other methods may be used to drain the runoff water. The material used to construct the slotted openings must withstand an equivalent fluid pressure of 60 $lb/ft^3/ft$ (27.2 $kg/m^3/m$) height when it is a part of the outside wall. For "false" walls inside the main structure the load may be reduced to 45 $lb/ft^3/ft$ (20.4 $kg/m^3/m$) height.

The shape and height of the stack shall be determined by the method used to stack the manure, amount of bedding in the manure, and the farmer's desire. Manure with little bedding will slump and cannot be stacked as high as manure with considerable bedding. Slurry or semi-liquid manure without bedding, such as that from free-stall dairy housing, does not stack well. Design as a level surface.

All storage structures and stacking platforms must be constructed on soils which will provide even settlement. Unequal settlement may result from poor quality soils or significant changes in the compressibility of the substrata soils (i.e. rock). Special designs for these conditions might include, but not be limited to, the following:

Poor quality soils - excavate the undesirable soils and backfill with compacted earthfill that meets the gradation and minimum depth shown in Table 2.

Rock - the entire structure floor will not be below the existing bedrock surface. If rock is encountered beneath a portion of the floor or within 8 ft (2.4 m) of a wall of the structure, a layer of compacted backfill which meets the gradation and minimum thickness shown in Table 2 shall completely cover the exposed bedrock that is at the top of the wall elevation or lower. The compacted backfill shall extend at least 6 ft (1.8 m) beyond the structure wall to allow free drainage of runoff water. The slope of the backfill shall not be steeper than 2 horizontal to 1 vertical (2:1). See figure 3. The design must consider the compressibility of this backfill layer to the deeper soil layer where rock was not excavated. A

sand-gravel material at least 6 in (15 cm) thick shall be installed under the structure floor. A conduit drain with a minimum diameter of 3 in (7.6 cm) shall be installed in the sand-gravel material. The drain shall be encased in a minimum of 3 in (7.6 cm) of sand-gravel material. The top of the drain shall be at least 6 in (15 cm) below the bottom of the concrete slab. The drains shall be at least 5 ft (1.5 m). and no more than 25 ft (3 m) from the outside edges of the concrete. The maximum spacing between drains shall be 50 ft (15.2 m). The drain shall outlet on soil which has a minimum thickness for the soil type shown in table 2. See figure 3.

Structural loadings

Waste storage structures shall be designed to withstand all anticipated loads. Loadings include internal and external loads, hydrostatic uplift pressure, concentrated surface and impact loads, and frost or ice pressure.

The lateral earth pressure should be calculated from soil strength values determined from the results of appropriate soil tests. If soil strength tests are not available, the minimum lateral earth pressure values indicated in table 1 shall be used.

Lateral earth pressures based upon equivalent fluid assumptions shall be assigned according to the structural stiffness or wall yielding as follows:

1. Rigid frame or restrained wall. Use the values shown in table 1 under the column "Frame Tanks," which gives pressures comparable to the at-rest condition.

2. Flexible or yielding wall. Use the values shown in table 1 under the column "Freestanding Wall," which gives pressures comparable to the active condition. Walls in this category are designed on the basis of gravity for stability or are designed as a cantilever having a base thickness to height ratio not more than 0.085.

An internal hydrostatic load of 60 lb/ft^2/ft (961 kg/m^2/m) of depth shall be used for design. If heavy equipment is to be operated within 5 ft (1.5 m) of the walls, a surcharge (horizontal pressure) of 100 lb/ft^2 (488 kg/m^2) on the wall shall be added. Covers for waste storage structures shall be designed to withstand both dead and live loads. The live load values for covers contained in ASAE EP378 (Floor and Suspended Loads on Farm Structures Due to Use) and in ASAE EP393 (Solid and Liquid Manure Storage) shall be the minimum used. The actual axle load for tank wagons having more than a 2,000-gal (7,570 L) capacity shall be used. If the facility has a roof, snow and wind loads shall be as specified in ASAE ~~S288~~ EP288.5 (Designing Buildings to Resist Snow and Wind Loads). The minimum loadings used in Wisconsin shall be: 8/96

Wind load-basic velocity pressure	16 lb/ft^2 (766 Pa)
Snow load	24 lb/ft^2 (1149 Pa)

Table 1. Lateral Earth Pressure Values [1]

Soil		Equivalent fluid pressure ($lb/ft^2/ft$ of depth) ($kg/m^2/m$) Above seasonal high water table [2]	
Description	Unified classification	Free-standing wall	Frame tanks
Clean sand, gravel, or sand-gravel mixtures [2] (Maximum 5% fines)	GP, GW, SP, SW	30 (481)	50 (801)
Well-graded sand, silt, and clay mixtures (less than 50% fines)	SC, SC-SW, GM GM-GP, SM, SM-SW, SM-SP, GC, GM-GW, GC-GP, GC-GW	35 (561)	60 (961)
Low-plasticity silts and clays with significant sand and gravel of fine silty and clayey sands (more than 50% fines)	Gravelly sandy CL and ML, or fine SC or SM	45 (721)	75 (1201)
Low- to medium-plasticity silts and clay lacking in sand and gravel (more than 50% fines)	CL, ML	65 (1041)	85 (1362)
High liquid limit silts and clays	CH, MH [3]	--	100 (1602)

[1] For lightly compacted soils (85% to 90% maximum standard density). Includes compaction by use of typical farm machinery.

[2] Generally, only washed materials are in this category.

[3] Unsuitable for backfill.

If a waste storage structure is to serve as part of a foundation or support for a building, the total load shall be considered in the structural design.

Potential uplift pressures shall be eliminated by drainage or be included in the structural design (including bouyancy and flotation).

Structural design

The structural design shall consider all items that will influence performance, such as design analyses, methods, and assumptions; construction methods and quality control; and operational exposure, use, maintenance, and repair.

Storage tanks may be designed with or without covers. Covers, beams, or braces that are integral to structural performance must be indicated on the construction drawings. The openings in covered storage tanks shall be designed to accommodate equipment for loading, agitating, and emptying and shall be equipped with grills or secure covers for safety and odor and vector control.

Aboveground waste storage structures shall have adequate footings extending below the anticipated frost depth. See page 12-16a in the Agricultural Waste Management Field Manual.

Minimum requirements for waste storage structures are specified below:

1. Steel. AISC Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings.

2. Timber. NFPA National Design Specifications for Wood Construction. Lumber or timber for structures shall be treated with a wood preservative as follows:

Item	TREATMENT RETENTION IN LB/FT^3			
	Creosote-Petroleum solution	Penta-chloro-phenal	Amonical copper arsenite (ACA)	Chromated copper arsenite (CCA)
Lumber	8.0	0.4	0.25	0.25
Timbers	10.0	0.5	0.40	0.40
Poles	9.0	0.45	0.60	0.60

3. Reinforced concrete.

Service life	Specification
Short (minimum of 10-yr).	ACI 318
Medium (minimum of 20-yr)	ACI 318 modified as follows: a. The maximum ratio of tension steel reinforcement shall be 0.50 p_b. b. The required strength to resist all anticipated loads shall be based on a minimum load factor of 1.8. c. Flexural reinforcement is proportioned so the quantity z does not exceed 145. d. Service load stresses in flexure shall not exceed 0.40 f'_c.
Long (minimum of 50-yr)..	ACI 350 R.

4. Masonry concrete. ACI 531.

5. Nonstructural concrete slab. The minimum thickness of slabs for tanks and manure storage platforms shall be 5 in (12.7 cm) ~~except for slabs cast on plastic sheeting over sand the minimum thickness shall be 4 in (10.1 cm).~~ 3/96 The minimum reinforcement for slabs with a span of 30 ft (9.1 m) or less shall be equal to that of 6 x 6 - W1.4 x W1.4 (10ga) (152 x 152 MW9.1 x MW9.1) welded wire fabric. Slabs having a span greater than 30 ft (9.1 m) shall be provided with control joints at a maximum spacing of 30 ft (9.1 m) or shall have additional steel reinforcement. When liquid-tight concrete is required and construction joints are used as control joints, the joint shall contain a waterstop or an elastomeric sealant which adheres to the concrete on both sides of the joint. Waterstops shall be copper or non-metallic vinyl chloride polymer material. Nonmetallic waterstop shall have ribbed or bulb-type anchor flanges. A nonsag (not self-leveling during application) cold-applied elastomeric type joint sealing compound for concrete construction can be used to seal control joints that are sawed or molded into slabs.

   Construction joints not used as control joints shall have either a conventional keyway or a 1/4 in (0.6 cm) thick, 6 in (15.2 cm) wide steel plate placed in the center of the slab.

6. Flexible membranes. Flexible membranes shall meet or exceed the requirements of flexible membrane linings specified in SCS standard 521-A.

7. Coatings. Coatings shall be approved in accordance with procedures in the National Engineering Manual (210-512.20 to 512.23).

8. Glass fiber reinforced plastics/resins and glass-fused steel. Products shall be approved in accordance with procedures in the SCS National Engineering Manual (210-512.20 to 512.23).

Safety

Entrance ramps shall be no steeper than 8 horizontal to 1 vertical. Warning signs, ladders, ropes, bars, rails, and other devices shall be provided, as appropriate, to insure the safety of humans and livestock. Ventilation and warning signs must be provided for enclosed wasteholding structures, as necessary, to prevent explosion, poisoning, or asphyxiation. Pipelines from enclosed buildings shall be provided with a water-sealed trap and vent or similar devices to control gas entry into the buildings.

Operation and Maintenance

Operation and maintenance shall be in accordance with the requirements specified in the overall waste management plan.

Plans and Specifications

Plans and specifications for waste storage structures shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

All construction drawings, including approved standard structural plans, should include details concerning the overall plan and layout of the facility. It should show location of milkhouse, well, nearby buildings, and similar features. Standard plans can often be used for single components of an overall plan.

When structures which have been prequalified are installed, a statement from the supplier shall be obtained providing sufficient data and information indicating the proper size and model have been furnished and installed and that the requirements of the specifications and the drawings have been met.

Design Documentation Requirements

Computations for required capacity (Form WI-CPA-1), dimensions of structure, type of materials, required service life, logs for foundation investigations, mechanical analysis of soil material (fines), pertinent elevations, distance to wells, seeding requirements if applicable.

Construction (As Built) and/or Certification Documentation Requirements

Dimensions of installed structure, description of structure, brand name (if applicable), pertinent elevations, documentation of inspections or certifications for items such as concrete and reinforcing steel, adequacy of seeding if applicable.

TABLE 2 - SEE TABLE 2, PAGE 13 FOR OTHER FORMAT

DISTANCE MORE THAN 100 FEET (30.5 m) FROM WELL 1/ 3/

SOILS: % FINER THAN #200 SIEVE	SOILS: THICKNESS TO BEDROCK OR GROUND-WATER (FT) 2/	STORAGE FACILITY TYPE
	≥5.0	IA; IB; IAR; IBR IIA; IIPB; IIAR; IIPBR IIIA; IIIPB; IIIAR; IIIPBR
>50	3.0-4.9	IA; IB; IAR; IBR IIA; IIPB; IIAR; IIPBR IIIA; IIIPB; IIIAR; IIIPBR
	2.0-2.9 3/	IA; IB; IAR; IBR IIAR; IIPBR*
	≥5.0	IA; IB; IAR; IBR IIA; IIPB; IIAR; IIPBR IIIA; IIIPB*; IIIAR; IIIPBR
25-50	3.0-4.9	IA; IB; IAR; IBR IIA; IIPB; IIAR; IIPBR IIIAR; IIIPBR*
	2.0-2.9 3/	IA; IB; IAR; IBR IIAR; IIPBR*
	≥5.0	IA; IB; IAR; IBR IIA; IIPB*; IIAR; IIPBR IIIAR; IIIPBR*
12-24	3.0-4.9	IA; IB; IAR; IBR IIAR; IIPBR*
	2.0-2.9 3/	IA; IB; IAR; IBR IIAR; IIPBR*
	≥5.0	IA; IB; IAR; IBR IIA**; IIPB**; IIAR; IIPBR*
<12	3.0-4.9	IA; IB; IAR; IBR IIAR; IIPBR*
	2.0-2.9 3/	IA; IB; IAR; IBR IIAR; IIPBR*

5.0 1.52 m; 4.9 ft = 1.49 m; 3.0 ft = 0.91 m;
2.9 0.88 m; 2.0 ft = 0.61 m

LEGEND:

TYPE I - STORAGE TANKS OR STRUCTURES - (LIQUID-TIGHT FLOOR AND WALLS; TO CONTAIN LIQUID, SEMI-SOLID AND SOLID MANURE)

TYPE II - MANURE STORAGE PLATFORM - ESSENTIALLY LIQUID-TIGHT - (LIQUID-TIGHT FLOOR WITH WALLS THAT ALLOW MINIMAL SEEPAGE; FOR SEMI-SOLID AND SOLID MANURE)

TYPE III - MANURE STORAGE PLATFORM WITH ACCEPTABLE DRAINAGE SYSTEM - (LIQUID-TIGHT FLOOR WITH DRAINAGE OF PRECIPITATION RUNOFF AND LEACHATES THROUGH THE WALL; SEMI-SOLID OR SOLID MANURE ONLY; ACCEPTABLE DRAINAGE SYSTEM REQUIRED

A = ABOVE GROUND
AR = ABOVE GROUND WITH ROOF
B = BELOW GROUND
BR = BELOW GROUND WITH ROOF
PB = PARTIALLY BELOW GROUND
PBR = PARTIALLY BELOW GROUND WITH ROOF

* = SURFACE DRAINAGE AROUND THE ENTIRE STRUCTURE FLOOR PERIMETER

** = SPECIAL DRAINAGE DESIGN FOR TYPE II STRUCTURES (WITHOUT ROOFS) WHICH ARE CONSTRUCTED ON SOILS WHICH:
(1) HAVE LESS THAN 12 PERCENT OF THE MATERIAL PASSING THE #200 SIEVE, AND
(2) ARE AT LEAST 5 FT (1.52 m) THICK.
A SOIL LAYER NOT LESS THAN 2 FT (0.61 m) THICK WHICH HAS A MINIMUM OF 25 PERCENT OF THE MATERIAL PASSING THE #200 SIEVE SHALL BE CONSTRUCTED AROUND THE PERIMETER OF THE FLOOR. THE SOIL LAYER SHALL EXTEND AT LEAST 6 FT (1.83 m) OUTSIDE OF THE CONCRETE BASE AND AT LEAST 5 FT (1.52 m) UNDER THE FLOOR (TOP WIDTH OF CROSS SECTION). SEE FIGURE 2. THE SOIL SHALL BE COMPACTED BY AT LEAST ONE TREAD TRACK OF THE LOADED EQUIPMENT THAT COVERS THE ENTIRE SURFACE OF A MAXIMUM 8 IN (20.3 cm) LAYER (PRIOR TO COMPACTION). POST HOLES FOR WOOD WALLS SHALL BE BACKFILLED WITH CONCRETE.

> = GREATER THAN
≥ = GREATER THAN OR EQUAL TO
< = LESS THAN

EXAMPLE: IIPBR* = TYPE II STRUCTURE, PARTIALLY BELOW GROUND, WITH ROOF AND SURFACE DRAINAGE AROUND THE ENTIRE FLOOR PERIMETER. ALSO SEE PAGE 14.

1/ = DISTANCE IS EQUAL TO THE HORIZONTAL MEASUREMENT FROM THE WELL TO THE WALL OF THE STORAGE FACILITY.

2/ = THICKNESS IS THE VERTICAL DISTANCE FROM GROUNDWATER OR BEDROCK TO THE TOP OF THE STRUCTURE FLOOR WITH GRAVEL BEDDING EXCLUDED. THICKNESS IS EQUAL TO TO THE THICKNESS OF THE SOIL AND THICKNESS OF THE CONCRETE. THE SOIL MUST HAVE THE PERCENT OF FINES SHOWN. NOTE!!! THE THICKNESS OF THE GRAVEL BEDDING MUST BE ADDED TO THE THICKNESS SHOWN IN THIS TABLE. (i.e. BEDDING = 0.5 FT (0.15 m), DEPTH = 2.5 FT (0.76 m) OR 3.5 FT (1.07 m), WHICHEVER APPLIES).

3/ = NOTE!! WHEN THE STRUCTURE FLOOR IS LESS THAN 3 FT (0.91 m) ABOVE GROUNDWATER ? BEDROCK, NR 112 REQUIRES A MINIMUM DISTANCE OF 150 FT (45.7 NY SSER DISTANCE REQUIRES A DNR VARIANCE. DNR MAY OR MAY NOT GR /ARIANCE ASED ON AN EVALUATION OF THE SITE SPECIFIC CIRCUMSTANCES.

TABLE 2 (CONTINUED) SEE TABLE 2, PAGE 12 FOR OTHER FORMAT.

DISTANCE MORE THAN 100 FEET (30.5 m) FROM WELL 1/ 3/

STORAGE FACILITY TYPE	SUB-TYPE	SOILS: MINIMUM % FINER THAN #200 SIEVE	SOILS: MINIMUM THICKNESS TO GROUNDWATER OR BEDROCK (FT) 2/
TYPE I - STORAGE TANKS OR STRUCTURES - LIQUID-TIGHT FLOOR AND WALLS; TO CONTAIN LIQUID, SEMI-SOLID OR SOLID MANURE.	IA	0	2.0 3/
	IB	0	2.0 3/
	IAR	0	2.0 3/
	IBR	0	2.0 3/
TYPE II - MANURE STORAGE PLATFORM - ESSENTIALLY LIQUID-TIGHT - LIQUID-TIGHT FLOOR WITH WALLS THAT ALLOW MINIMAL SEEPAGE; FOR SEMI-SOLID AND SOLID MANURE.	IIA	25 12	3.0 5.0
	IIA**	0	5.0
	IIPB	25	3.0
	IIPB*	12	5.0
	IIPB**	0	5.0
	IIAR	0	2.0 3/
	IIPBR	25 12	3.0 5.0
	IIPBR*	0	2.0 3/
TYPE III - MANURE STORAGE PLATFORM WITH ACCEPTABLE DRAINAGE SYSTEM - LIQUID-TIGHT FLOOR WITH DRAINAGE OF PRECIPITATION RUNOFF AND LEACHATES THROUGH THE WALL; SEMI-SOLID AND SOLID MANURE ONLY; ACCEPTABLE DRAINAGE SYSTEM REQUIRED.	IIIA	50 25	3.0 5.0
	IIIPB	50	3.0
	IIIPB*	25	5.0
	IIIAR	25 12	3.0 5.0
	IIIPBR	50 25	3.0 5.0
	IIIPBR*	25 12	3.0 5.0

5.0 ft = 1.52 m; 3.0 ft = 0.91 m; 2.0 ft = 0.61 m

LEGEND:

A = ABOVE GROUND
AR = ABOVE GROUND WITH ROOF
B = BELOW GROUND
BR = BELOW GROUND WITH ROOF
PB = PARTIALLY BELOW GROUND
PBR = PARTIALLY BELOW GROUND WITH ROOF

* = SURFACE DRAINAGE AROUND THE ENTIRE STRUCTURE FLOOR PERIMETER

** = SPECIAL DRAINAGE DESIGN FOR TYPE II STRUCTURES (WITHOUT ROOFS) WHICH ARE CONSTRUCTED ON SOILS WHICH:
(1) HAVE LESS THAN 12 PERCENT OF THE MATERIAL PASSING THE #200 SIEVE, AND
(2) ARE AT LEAST 5 FT (1.52 m) THICK.
A SOIL LAYER NOT LESS THAN 2 FT (0.61 m) THICK WHICH HAS A MINIMUM OF 25 PERCENT OF THE MATERIAL PASSING THE #200 SIEVE SHALL BE CONSTRUCTED AROUND THE PERIMETER OF THE FLOOR. THE SOIL LAYER SHALL EXTEND AT LEAST 6 FT (1.83 m) OUTSIDE OF THE CONCRETE BASE AND AT LEAST 5 FT (1.52 m) UNDER THE FLOOR (TOP WIDTH OF CROSS SECTION). SEE FIGURE 2. THE SOIL SHALL BE COMPACTED BY AT LEAST ONE TREAD TRACK OF THE LOADED EQUIPMENT THAT COVERS THE ENTIRE SURFACE OF A MAXIMUM 8 IN (20.3 cm) LAYER (PRIOR TO COMPACTION). POST HOLES FOR WOOD WALLS SHALL BE BACKFILLED WITH CONCRETE.

EXAMPLE: IIPBR* = TYPE II STRUCTURE, PARTIALLY BELOW GROUND, WITH ROOF AND SURFACE DRAINAGE AROUND THE ENTIRE FLOOR PERIMETER.
ALSO SEE PAGE 14.

1/ = DISTANCE IS EQUAL TO THE HORIZONTAL MEASUREMENT FROM THE WELL TO THE WALL OF THE STORAGE FACILITY.

2/ = THICKNESS IS THE VERTICAL DISTANCE FROM GROUNDWATER OR BEDROCK TO THE TOP OF THE STRUCTURE FLOOR WITH GRAVEL BEDDING EXCLUDED. THICKNESS IS EQUAL TO THE THICKNESS OF THE SOIL AND THICKNESS OF THE CONCRETE. THE SOIL MUST HAVE THE PERCENT OF FINES SHOWN. NOTE!!! THE THICKNESS OF THE GRAVEL BEDDING MUST BE ADDED TO THE THICKNESS SHOWN IN THIS TABLE. (i.e. BEDDING = 0.5 FT (0.15 m), DEPTH = 2.5 FT (0.76 m) OR 3.5 FT (1.07 m), WHICHEVER APPLIES)

3/ = NOTE!! WHEN THE STRUCTURE FLOOR IS LESS THAN 3 FT (0.91 m) ABOVE GROUNDWATER OR BEDROCK, NR 112 REQUIRES A MINIMUM DISTANCE OF 150 FT (45.7m). ANY LESSER DISTANCE REQUIRES A DNR VARIANCE. DNR MAY OR MAY NOT GRANT A VARIANCE BASED ON AN EVALUATION OF THE SITE SPECIFIC CIRCUMSTANCES.

EXAMPLES OF STRUCTURE TYPES:

TYPE I - LIQUID-TIGHT CONCRETE FLOOR AND WALLS:

ALL PRE-APPROVED PLANS PROVIDED BY COMPANIES *, or
SCS STANDARD DRAWING NO. 5,E-33,002 *

*SEE WISCONSIN SUPPLEMENT TO ENGINEERING FIELD MANUAL, CHAPTER 17.

TYPE II - LIQUID-TIGHT CONCRETE FLOOR WITH WALL CONSTRUCTION THAT ALLOWS MINIMAL SEEPAGE THROUGH THE WALLS:

WALLS MAY BE CONSTRUCTED OF THE FOLLOWING:

PRESSURE TREATED TONGUE AND GROOVE LUMBER WITH NO HOLES, or
CONCRETE THAT IS NOT LIQUID-TIGHT (NO WATERSTOPS), or
PREFABRICATED CONCRETE PANELS

TYPE III - LIQUID-TIGHT CONCRETE FLOOR WITH WALL CONSTRUCTION THAT CONTAINS PRECICIPITATION RUNOFF AND LEACHATES IN ANY PORTION OF THE STRUCTURE AND ALLOWS DRAINAGE OF THESE LIQUIDS REQUIRES AN ACCEPTABLE DRAINAGE SYSTEM:

WALLS MAY BE CONSTRUCTED OF CONCRETE OR PRESSURE TREATED TONGUE AND GROOVE LUMBER WITH THE FOLLOWING ADDITIONS OR MODIFICATIONS:

HOLES THROUGH THE WALL (DRILLED OR FORMED), or
VERTICAL SLOTTED OPENINGS ON ONE SIDE OR PARTIAL SIDE, or
VERTICAL SLOTTED OPENINGS IN CORNERS AND NEAR THE LOADING RAMP IN CONJUNCTION WITH LIQUID-TIGHT CONVEYANCE SYSTEM TO CONVEY LIQUIDS TO AN ACCEPTABLE LOCATION.

Table 3 — Daily Manure Production for Livestock 1/

Kind of Livestock	Weight/Animal	Cubic Feet Per Day		
		Solids	Liquids	Total
Dairy Cattle	1000	1.1	0.5	1.6
	1200	1.4	0.5	1.9
	1400	1.6	0.6	2.2
	1600	1.8	0.7	2.5
Beef Cows	1000	0.8	0.3	1.1
	1200	0.9	0.4	1.3
	1400	1.0	0.5	1.5
	1600	1.1	0.6	1.7
Feed Lot Cattle	400	0.5	0.2	0.7
	600	0.7	0.3	1.0
	800	0.9	0.4	1.3
	1000	1.0	0.4	1.4
	1200	1.2	0.5	1.7
Heifers, 10 months to freshening				1.1
Calves, 1-1/2 - 10 months				0.5
Calves, up to 1-1/2 months, excluding wash water for veal operations. Allow .5 to .7 cubic foot for wash water.				0.2
Swine	50			.07
	100			.13
	150			.20
	200			.25
	250			.33
Bred Sow (limit fed)				.13
Lactating Sows with Litter				.50

1/ Source - "Solid Manure Handling for Livestock Housing, Feeding, and Yard Facilities in Wisconsin" by E. C. Bruns and J. W. Crowley; Publication A2418, November 1972; University of Wisconsin Extension

and

"Livestock Waste Facilities Handbook", Midwest Plan Service - 18, 1975.

Table 4 -- Daily Manure Production For Poultry 1/

Kind of Poultry	Cubic Feet Per Day per 1000 Birds
Laying hens	4
Broilers	1.63
Turkeys	7.54

1/ Source - "Solid Manure Handling for Livestock Housing, Feeding, and Yard Facilities in Wisconsin" by E. C. Bruns and J. W. Crowley; Publication A2418, November 1972; University of Wisconsin-Extension

and

"Livestock Waste Facilities Handbook", Midwest Plan Service - 18, 1975.

Table 5 -- Volume Allowance For Straw Bedding 1/

Straw Used Per Day Per A.U. (lbs.)	Loose Straw Cu.Ft. Per Day Per A.U.	Chopped or Baled Straw Cu.Ft. Per Day Per A. U.
2	.25	.13
4	.50	.26
6	.75	.39
8	1.00	.52
10	1.25	.65
12	1.50	.78

1/ Source - "Solid Manure Handling for Livestock Housing, Feeding, and Yard Facilities in Wisconsin" by E. C. Bruns and J. W. Crowley; Publication A2418, November 1972; University of Wisconsin-Extension

and

"Livestock Waste Facilities Handbook", Midwest Plan Service - 18, 1975.

Table 6 -- Volume of Milkhouse and Parlor Wastes 1/

Washing Operation	Water Volume
Bulk tank	
Automatic	50-60 gal/wash
Manual	30-40 gal/wash
Pipeline	
In parlor (Volume increases for long lines in a large stanchion barn.)	75-125 gal/wash
Pail milkers	30-40 gal/wash
Misc equipment	30 gal/day
Cow prep	
Automatic	1-4 1/2 gal/wash per cow
Estimated average	2 gal/wash per cow
Manual	1/4-1/2 gal/wash per cow
Parlor floor	40-75 gal/day
Milkhouse floor	10-20 gal/day

1/ Source - "Livestock Waste Facilities Handbook", Midwest Plan Service - 18,

Table 7 -- Monthly Runoff From Barnyards and Feedlots in Wisconsin 1/

Month	Runoff Curve Number -- (AMC II)			
	RCN=85 2/	RCN=90 3/	RCN=95 4/	RCN=98
	(Inches)	(Inches)	(Inches)	(Inches)
January	0.6	0.7	1.1	1.5
February	0.6	0.7	1.1	1.5
March	1.9	2.2	3.5	4.7
April	2.2	2.7	4.1	5.5
May	1.4	1.7	2.6	3.5
June	1.1	1.3	2.0	2.6
July	0.7	0.8	1.3	1.7
August	0.6	0.7	1.1	1.5
September	0.7	0.8	1.3	1.7
October	0.7	0.8	1.3	1.7
November	0.7	0.8	1.3	1.7
December	0.6	0.7	1.1	1.5
TOTAL	11.8	13.9	21.8	29.1

1/ Due to the many variables involved, figures shown are for average conditions in Wisconsin. Figures were derived from procedures similar to example on page 12-68, Agricultural Waste Management Field Manual, with modifications for snow accumulation, snow melt and dormant seasons of the year.

2/ Recommended for unpaved barnyards and feedlots having slopes of 4 percent or flatter.

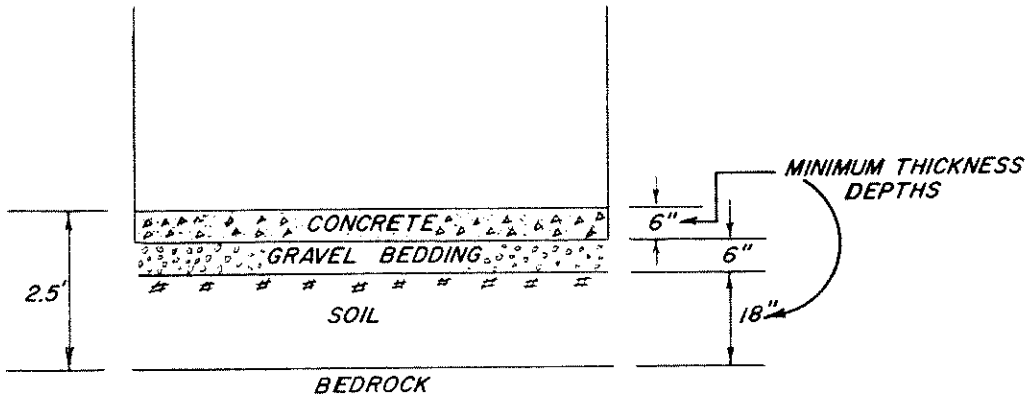
3/ Recommended for unpaved barnyards and feedlots having slopes greater than 4 percent.

4/ Recommended for paved barnyards and feedlots.

Table 8 -- Monthly Values For Precipitation and Evaporation in Wisconsin 1/

Month	Ave. Precip. (Inches)	Ave. Evap. (Inches)	Net (Inches)
January	1.1	0.3	0.8
February	0.9	0.3	0.6
March	1.8	0.7	1.1
April	2.7	1.5	1.2
May	3.8	2.3	1.5
June	4.4	3.6	0.8
July	3.8	5.0	-1.2
August	3.5	5.1	-1.6
September	3.7	4.0	-0.3
October	2.2	2.6	-0.4
November	1.9	1.5	0.4
December	1.3	0.5	0.8
Annual	31.1	27.4	3.7

1/ Source - Precipitation - "Climatological Data Annual Summary, 1976, NOAA". Average values from several stations.
Evaporation - "Mean Monthly Evaporation From Shallow Lakes and Reservoirs"; Standard Drawing ES-1016 (13 sheets). Material from deleted section of SCS National Engineering Handbook, section 4.



THICKNESS: 18" + 6" = 24" = 2FT (MINIMUM ALLOWED)

TOTAL DEPTH = 18" + 6" + 6" = 30" = 2.5'

FIGURE 1. TYPICAL SECTION OF STRUCTURE BASE.

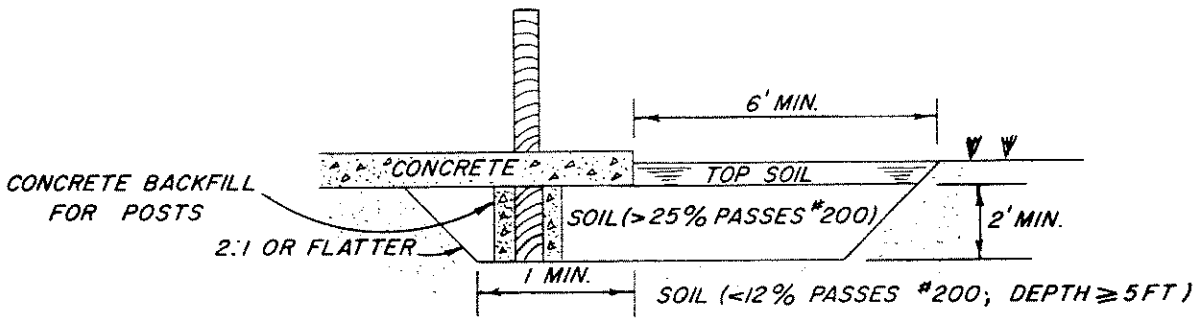


FIGURE 2. SPECIAL DRAIN FOR COARSE GRAINED SOILS. (TYPE II A & II PB ONLY)

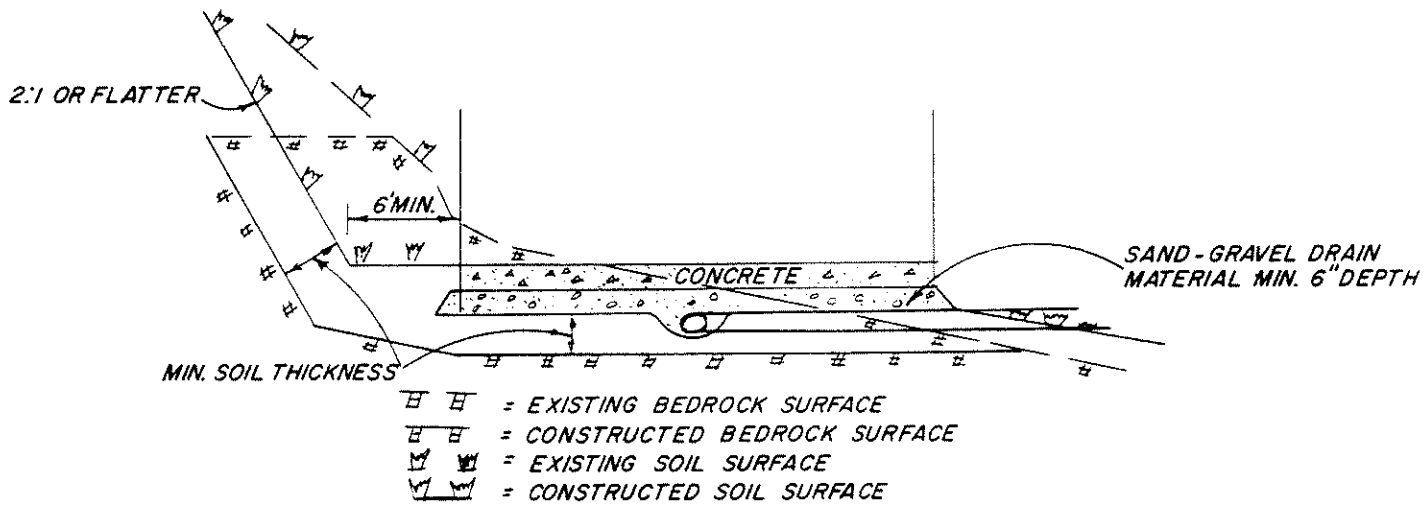


FIGURE 3. STRUCTURE PARTIALLY BELOW BEDROCK SURFACE.