Farm Structures
FACTSHEET

BRITISH COLUMBIA
Ministry of Agriculture and Food

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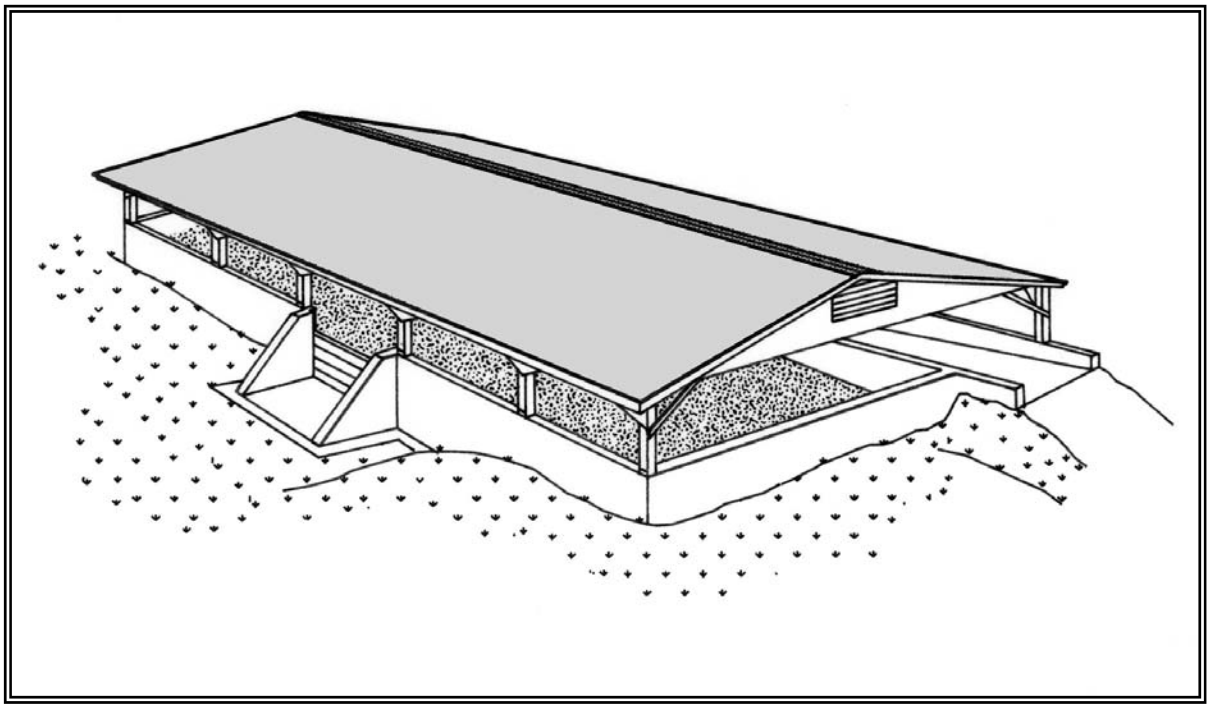
# MANURE STORAGE STRUCTURES



## MANURE STORAGE STRUCTURES

A well-planned manure storage system is an asset to any livestock enterprise. Livestock manure is a valuable fertilizer for farm crops and sustainable agriculture. It should be stored in a structure that will retain nutrients for application during crop growth. A poor management system leads to untimely application of manure to land and the potential of pollution to our environment. This note explains some of the factors to be considered in a good manure storage structure.

## ENGINEERED STRUCTURAL PLANS

Assistance in planning is available through the Resource Management Branch of the BC Ministry of Agriculture and Lands. Structural working drawings are not available from the BCMAL and therefore, must be designed by an engineering consultant. A list of consultants providing this service is available. See *Factsheet # 301.000-1*.

A manure storage structure must be designed according to the requirements of the ***Canadian Farm Building Code***. Manure storage plans should provide all the information required to locate and construct the facility so that it is structurally sound and functionally efficient. A plan for a typical concrete tank would include information on:

- design criteria as required under part 2 of the ***National Building Code***, which gives reference to the ***Canadian Farm Building Code***.
- location of the structure in relation to other buildings on the farm,

- type and strength of concrete to be used,
- thickness of concrete in the walls and floor,
- size and location of reinforcing steel,
- depth of tank below grade and any special footing requirements and,
- filling, agitating and emptying.

Good plans enable competitive bids to be obtained from building contractors. Building contractors can all quote on precisely the same structure and specified materials.

Engineered plans will make it possible to obtain a building permit where municipalities require engineered drawings of major farm structures before a building permit will be issued.

Specifications and design standards as set out on a plan can form the basis of any contractual agreements between the contractor and the farmer.

## ESSENTIAL FEATURES OF A MANURE STORAGE

The essential steps to planning a new manure storage are sizing the storage, locating the storage in relation to other buildings and preparing engineered drawings.

### Size of Storage

When sizing manure storage, consider the following points:

- how much manure is generated by all of the livestock on the farm and will livestock numbers increase in the near future?
- what is the minimum period of storage required for the farm? For most BC farms, four months is recommended and six months may be most desirable. Up to one year may be required depending on the crop planted and the ability to fertilize with manure. Sufficient length of storage should be provided to avoid spreading manure on land when there is a danger of runoff.
- where is contaminated runoff and waste-water draining? Additional storage for contaminated runoff from outside yards and wastewater from clean-up operations should be provided.
- Divert all clean water from roofs and other yard areas away from the manure collection area.
- Should the storage be covered? In high rainfall areas, it often makes good economic sense to roof manure storages to exclude precipitation which can be high as 1200 mm (48 in.) over a four month period in some south-coastal areas. This significantly reduces the manure storage capacity of the structure. See Factsheet # 383.100-2 *Sizing Dairy Manure Storage Facilities*. This note gives the approximate rainfall of several BC regions.

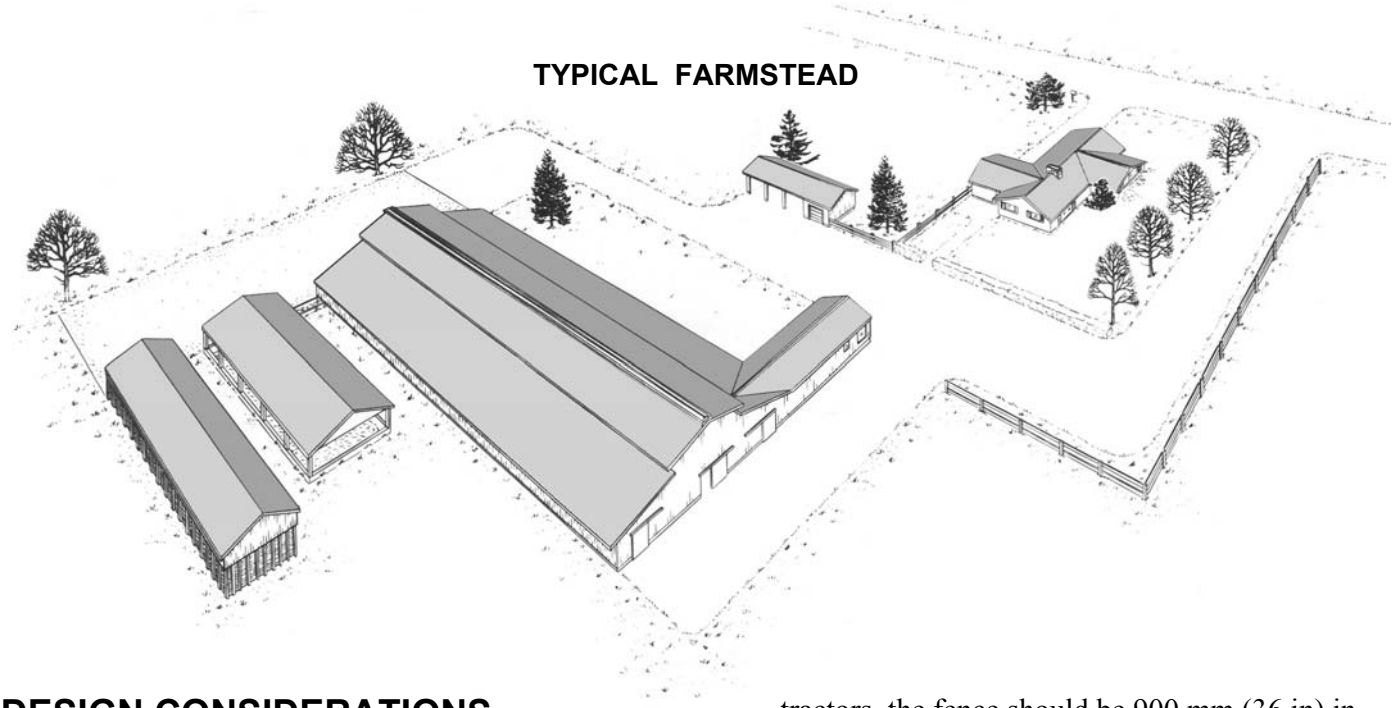
### Location of Storage

The location where the storage is built depends upon a number of factors. Consider the following:

- Allow room for expansion and access for agitation and clean-out.
- How is manure going to be handled? Carefully consider mechanical handling operations of how manure is to be collected, transported to the storage and eventually moved out of the storage to fields. See Factsheet #381.200-1 *Daily Scraping Manure Management Systems.*
- what are the restrictions of the building site? For example, where is the highest expected water table? The answer will determine how far in the ground a storage can be built.
- consider the direction of prevailing winds. Odors from the manure storage can be offensive around the farmhouse yard and possibly neighbours.
- odors from the manure storage can also be a problem around milk rooms and other food storage areas.

The size and location of the manure storage should be shown on a farmstead plan

**TYPICAL FARMSTEAD**



# DESIGN CONSIDERATIONS

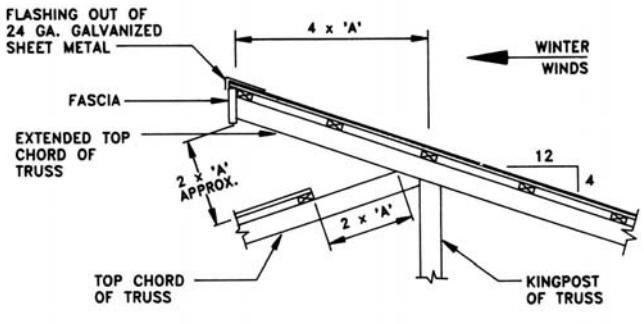
## Safety

1) All manure storages must incorporate safety features to protect livestock, farm workers and children. Some minimum requirements such as protective fencing is outlined in Part 4 of the ***Farm Building Code***. The safety requirements of the Workers' Compensation Board of British Columbia should also be incorporated in manure storage structures.

   Outside tanks, which incorporate a scrape ramp or suspended slab over the tank for tractor scraping of manure, require a heavy duty protective fence in this area. It should **not** be possible for the tractor to accidentally fall into the tank. This protective fence should be constructed of 100 mm (4 in.) welded steel pipe set in concrete. For most tractors, the fence should be 900 mm (36 in) in height. Do not use chain instead of pipe; tractors are capable of climbing right over a chain safety rail.

## Roofed Storage

2) A roof over manure storage structures can be built in two different methods. One method is using manufactured engineered trusses supported on stud wall framing with knee braces. Another method is support trusses on beams which in turn are supported on posts and also knee braced. These posts or stud walls will be anchored to the concrete manure storage walls. It is recommended that 3/8" sheathing grade plywood, or equivalent, be installed under the roofing to prevent corrosion of roof metal from manure gases. A continuous ridge ventilator is also recommended to exhaust these gases




NOTE: THESE DIMENSIONS RECOMMENDED FOR NATURAL CONVECTION VENTILATION.

| RIDGE VENT DIMENSIONS | |
|---|---|
| BUILDING WIDTH | 'A' DIMENSION |
| 20'–35' | 3 1/2" |
| 35'–45' | 4" |
| 45'–55' | 5" |
| 55'–65' | 6" |
| 65'–75' | 7" |
| 75'–85' | 8" |
| 85'–95' | 9" |
| 95'–105' | 10" |

**EXAMPLE OF OVERSHOT ROOF VENT**

## Width of Storage

3) The width of the manure storage structure may be limited by one or more of the following points:
   - The maximum span of manufactured engineered roof trusses.
   - The maximum reach of agitating equipment, particularly if access is limited to one side.
   - The maximum width of "race tracks" if the circulating agitation system is used. See Factsheet # 383.510-1 *Circulatory Agitation Systems for Dairy Manure Storage.*

## Length of Storage

4) The length of the manure storage may also be limited by agitating access for liquid or semi-solid storages. The slope of land and other site conditions may also limit manure storage dimension. A square structure versus a long rectangular structure, is the most economical shape, for the same volume of storage capacity.

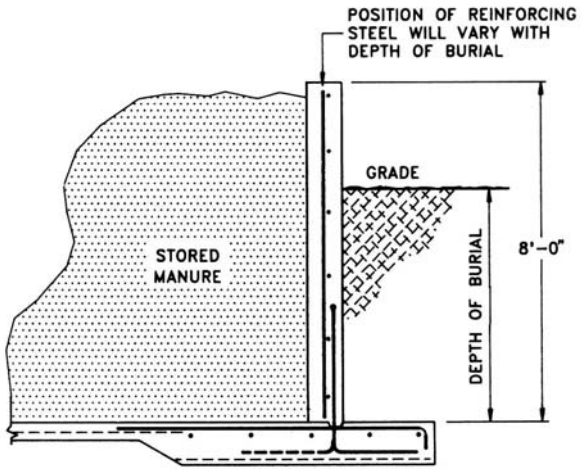
## Depth of Storage

5) The storage tank must be designed to withstand soils, manure and vehicle loads plus uplift if a high-water table exists. To prevent uplift of the concrete floor slab, the floor of the tank should not generally be located more than 600 mm (24 in.) below the highest expected groundwater table.

   Since the depth of the storage tank is limited by the highest expected water table, the storage capacity of the tank will be affected. A 2400 mm (8 ft.) depth is a practical design depth: tanks which are very shallow have a high cost of construction per cubic metre of storage: tanks which are very deep are difficult to agitate. A more serious problem is that most vacuum tankers cannot pump out tanks, which are deeper than 3000 mm (10 ft.). The tank should not be shallower than 1800 mm (6 ft.) and not deeper than 3000 mm (10 ft.).

## Tractor Access into Storage

6) Sediment buildup and crusting are potential problems for circulatory agitation systems. If possible, provide a tractor entrance to the tank to allow for complete clean out of heavy sediments,

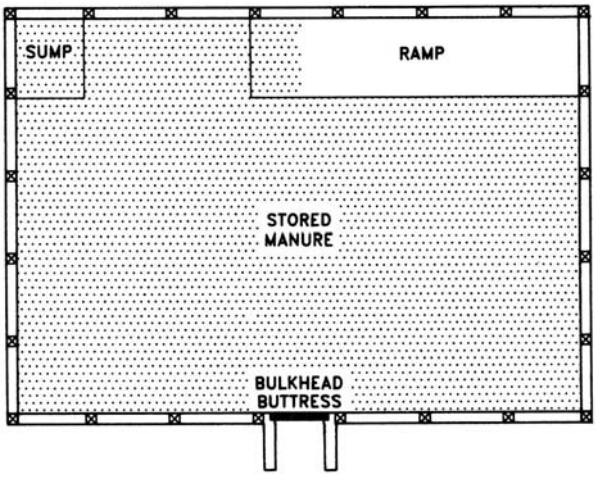



**TYPICAL MANURE STORAGE SHOWING RETAINING WALL DESIGN**

which may accumulate over a period of several years. This access is not meant to be used without proper safety equipment; an enclosed manure pit should not be entered unless the person entering is equipped with a self-contained breathing apparatus. For more information on manure gas hazards, see Factsheet #380.750-2 *Manure Gas.*

## Manure Removal from the Storage

7) Storage clean out must also be considered. A buttressed bulkhead will allow access for tractor clean out. Emptying can also be achieved by the use of an unloading ramp. If a pump is used, then a sump should be provided large enough to store one vacuum tanker load of manure. The sump will allow the pump suction hose to be completely immersed even when the storage is nearly empty. The sump floor should be 12" below the storage floor and the storage floor should slope towards the sump.




**TYPICAL FLOOR PLAN**

## Construction Modifications for Different Filling Methods

8) The design of the manure storage structure may also be affected by the filling method, as manure is transferred from the barn to the storage. Some filling methods are listed:

   a) Gutter cleaner. See the equipment supplier for specifications.

   b) *Gravity Flow Slurry Channel.* See Factsheet # 383.350-1.

   c) Alley scrapers. See the equipment supplier for specifications.

   d) Tractor scraping onto a ramp over the manure storage. A structural engineer must design the ramp or bridge.

   e) Manure pumps such as augers, air pumps, piston pumps, centrifugal chopper pumps. See the equipment supplier for specifications. See also Factsheet # 381.200-1 *Daily Scraping Manure Management Systems for Dairy Farms*. This note further describes the above pumps and manure transfer methods.

   f) Pull plug systems in swine barns

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**The following is a list of publications that have been referred to in this Factsheet.**


*301.000-1 Engineering Consulting Services for Agricultural Buildings*

*380.750-2 Manure Gas*

*381.200-1 Daily Scraping Manure Management Systems*

*383.100-2 Sizing Dairy Manure Storage Facilities*

*383.350-1 Gravity Flow Slurry Channels for Dairy Manure*

*383.510-1 Circulatory Agitation Systems for Dairy Manure Storage*


For a complete list of publications, see the Resource Management Branch *Publication List.*

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