Farm Structures FACTSHEET

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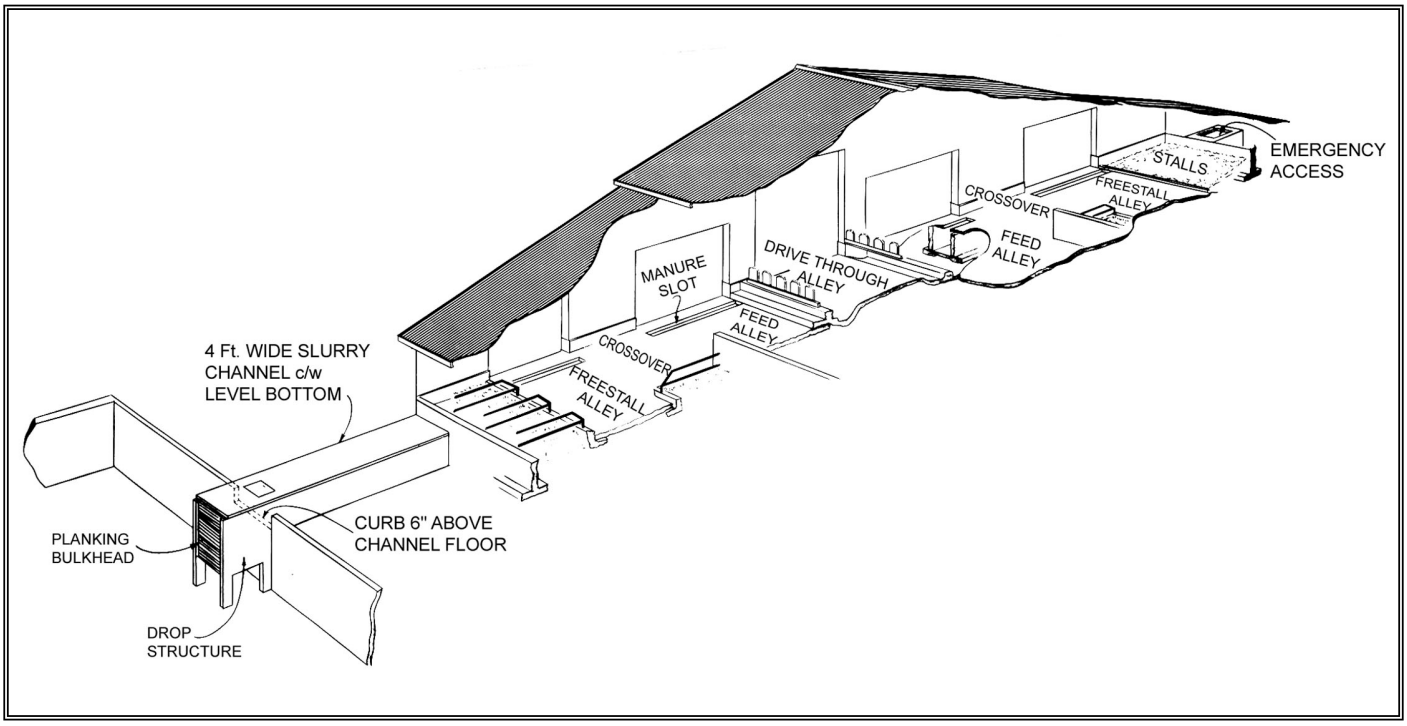
GRAVITY FLOW SLURRY CHANNELS FOR DAIRY MANURE



Gravity flow slurry channels are popular as a method of dairy manure transfer in liquid manure handling systems. Proper management of slurry channels is essential to their satisfactory operation. With good design and careful management, trouble-free operation is easy to realize.

Dairy manure from free stall barns has a moisture content of 88% to 95%. Even though the material is not purely liquid, gravity will cause the slurry to slowly flow. The manure surface in a channel naturally forms a slope which typically ranges from 0.5% to 2%. Dry manure (with a moisture content of less than 88%) will assume a slope of more than 2% and will not flow well.

ADVANTAGES OF A SLURRY CHANNEL

- Reduction or elimination of mechanical manure handling systems required for transfer of manure from the barn to a storage structure.
- Simple design and operation.
- High reliability.
- No need for agitation of manure inside the barn.

DISADVANTAGES OF A SLURRY CHANNEL

- No option for the incorporation of sand bedding unless a mechanical bucket system is introduced within the channel as well.
- Inability to handle manure which is frozen, dry, or contains an excess of long hay, straw, or sawdust bedding.
- Requirement for site topography or building design to incorporate the manure storage or reception pit to be at a lower elevation than the livestock barn.

CHANNEL DESIGN

The consistency of any manure is variable depending on the nature of the feed ration, class and age of animal, bedding type, and the degree to which the manure is frozen or has dried. It is essential that the channel be designed to handle the wide range of possible consistencies. This ensures that the channel will continue to operate satisfactorily at different times of the year or when changes in feed ration are made.

The cover page sketch shows a manure channel design that follows the recommendations contained in this leaflet. Every barn layout is different, but if the design criteria listed below are followed carefully, the channel will work well.

1. Channel width should be approximately 1200 millimetres (about 4 feet). This is a practical dimension that is easy to build and lends itself to functioning well. Narrower channels should not be used because sidewall friction and crust buildup tend to slow down manure flow and plug the channel. Since wider channels are more expensive to build and provide no significant improvement in performance, widths greater than 1200 mm are not justified.
2. Channel depth should be a minimum of 1200 millimetres (4 feet). Channels shallower than this are more prone to plugging. The longer the channel is, the deeper it should be. Use Table 1 below to determine the minimum required depth. Channels may, however, be built to a depth equal to or greater than the minimum shown. Many operators prefer to spend the extra money and construct their channels 2400 mm (8 ft) deep for improved reliability and some additional storage.
3. Channel length should be minimized as much as is practical and generally should not exceed 50 metres (or about 165 feet) in length. The maximum allowable length of channel is somewhat dependent on its chosen width and depth.
4. A channel lip or ledge is required at the discharge end of the channel. This lip is critical to satisfactory operation. Practical experience shows that a lip height of between 150 mm and 300 mm (6 inches to 12 inches) works well. Coarse solids and fibrous material tend to stratify by floating above a suspension of fine particles and water. The lip acts as a small dam that holds back a continuous layer of liquid along the bottom of the channel. This layer of liquid is like a lubricant that results in the manure flowing more readily.
5. The channel bottom should be dead level**.**
6. A channel cover made of wood or concrete helps to prevent freezing and premature drying of the manure in the channel. The channel should not be open to the air at any point along its length.
7. A drop structure at the outfall to the pit, such as the one illustrated on the cover page, is a simple and valuable part of any good channel design to minimize freezing of the manure caused by winter winds entering the channel.
8. It is necessary for the manure storage or reception pit to be lower than the barn floor because the manure surface slopes downward as it flows. If the pit is at the same level as the barn, it will not be possible to fill the pit to the top. Table 1 can be used to determine how much lower the pit should be in relation to the barn floor.
9. If parlour or milk room waste water is to be included as part of total manure pit volume, it is an excellent idea to introduce this water to the channel itself. Wash water or wastewater added to the upstream end of the channel assists in manure flow. A minimum 150-mm-diameter (6-inch) pipe from the parlour to the channel should be used. The pipe should include a one-way flap valve. The parlour must be higher than barn floor level if gravity flow of the waste water is to be relied on.

Parlour and dairy water will not drain to the channel, particularly if it is full. If design and topography constraints do not allow gravity flow, a pump system will need to be incorporated.

10. If possible, provide access for a vacuum tanker to add water to the upstream end of the channel. Should the channel plug for any reason, the tanker can help to clean the channel out with a flush of water. This same access location can also be designed to accommodate a PTO-powered agitator if the channel is designed with two legs for circulatory flow.
11. The location of the channel in relation to livestock barn layout is important. The channel is best located so that the drop slots are located in direct line with the cattle alleys. This simplifies scraping chores since the tractor operator does not have to turn any corners or jockey the tractor back and forth to push the manure into the slots. Manure deposition is then easily accomplished with a quick straight pass over the slot.
12. The drop slots should be centered over the channel and should extend the full alley width from one curb to the opposite curb. A good drop slot cover can be made of minimum thickness 5-mm (3/16 inch) galvanized steel checker plate. This type of design cannot be kicked out by the cows and is long lasting. The slot opening should be no more than 225 mm (9 inches) wide with a 25-mm-wide (1 inch) support lip all round. A larger slot opening is not desirable because the front wheel diameters of some tractors can be relatively small.
13. Another design option is to use raised cross alleys instead of the more conventional types that are even with the main traffic alleys. This makes the cattle alleys easier to clean because the tractor scraper is able to ride along a curb for the full length of the alley. The disadvantage to raised cross alleys is that they will require hand cleaning or manual washing. Tipping water troughs located at cross alley locations can also be dumped to facilitate easier cleaning.

MANAGEMENT POINTS

The management of gravity flow channel systems is by its very nature simple and convenient if one key requirement is always kept in mind: the manure that is deposited into the channel must be wet enough to flow from the outset. The following recommendations expand on this simple rule and are based on a survey of a large number of Fraser Valley farmers.

1. Sand bedding should never be used with a gravity flow manure channel system. The sand will accumulate in the bottom of the channel and eventually plug it. Sawdust or chopped hay or straw bedding should be used.
2. When starting the operation of a new gravity flow system, it is essential to fill the bottom of the channel with water. If the channel is dry, the manure will stick to the bottom and it will plug up. By starting with a layer of water, the channel will continue operating as intended from the beginning.
3. To reduce plugging problems, heifers and dry cows should be located on the side of the barn that is nearest to the manure pit. This is because heifer manure has a lower moisture content than cow manure and therefore does not flow as well. The thicker heifer manure will more easily be pushed along the channel by the wetter upstream milking cow manure.
4. When new bedding is put into the free stalls, the cows kick a substantial portion of it out during the first few days. This can cause the manure to be drier and may contribute to plugging. Water may need to be mixed in with the manure to counteract this problem. Suggestions for adding water are listed below.
5. The best way to ensure that water mixes with manure is to add it to the manure on the floor before scraping. During the scraping operation, the water is further mixed to produce a uniform, liquid slurry.
6. An overhead sprinkler line is a very convenient way to add water to manure lying on the floor. A 20-mm (about 3/4 inch) polyethylene pipe can be attached to the rafters or trusses above the free stall alleys. Uniform water applications are possible if the overhead lines are drilled with 2.5-mm-diameter (about 3/32 inch) holes at 3600-mm (about 12 feet) spacings. The drilled holes should be located at midspan between the pipe supports. This will be the low point in the line and will allow it to drain completely to prevent freezing in cold weather. A hand valve or a solenoid valve and timer can be used to control the amount of water to be added. When water is called for, the sprinkler line should typically be run from 10 – 20 minutes before scraping or while the cows are being held in a holding area prior to milking.
7. It may not be necessary to add water to the manure on the floor in all or any alleys. After a new slurry channel is installed, it is good practice

to experiment for a month or two before deciding to add an overhead water sprinkler line. In the end, extra water may only be required in the dry cow and heifer sections of the barn.

8. Some operators find that they only need to add water to the floor for a few weeks during the summer when the dry, hot air causes the manure to lose its moisture more quickly. A common method of adding water in these cases is to jam the drinking troughs open for a few minutes before scraping or to tip the troughs manually to release the wanted water. Water can also be added with a garden hose if smaller sections of the floor are drier than desired.
9. In some cases, there may be no other option but to leave the gravity flow channel inoperable during hot summer weeks. Particularly dry manure sections can either be cleaned by hand with the remainder done by tractor scraper and then transferred to storage with a front-end loader.
10. Another option for dealing with dry manure caused by bedding kicked out of free stalls is to simply leave the manure next to the curb and slowly mix it in with the wetter manure while tractor scraping over a period of three or four days. Leaving the dry manure next to the curb is acceptable if the cows' tails remain clean. Manure should not be left in this location for more than five days because semisolid manure is an ideal environment for fly breeding.

TABLE 1

MINIMUM REQUIRED CHANNEL DEPTH AND ELEVATION DROP FOR A GIVEN CHANNEL LENGTH

LENGTH		REQUIRED MINIMUM CHANNEL DEPTH		ELEVATION DROP FROM: FLOOR TO TOP OF PIT	
metres	feet	millimetres	inches	millimetres	inches
10	33	1200	48	200	8
15	49	1200	48	300	12
20	66	1200	48	400	16
25	82	1200	48	500	20
30	98	1350	54	600	24
35	115	1525	61	700	28
40	131	1700	68	800	32
45	148	1875	75	900	36
50	164	2050	82	1000	40

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