



Title: Guidelines for Hay Storage in Ontario

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Written by: Yves Choinière - Engineer (Farmstead Planning, Health and Safety)/OMAF; Jim Munroe -
Centre for Food and Animal Research/Agriculture Canada, Ottawa

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Introduction

This Factsheet is a compilation of the best knowledge from the Expert Committee of the Hay "Producers" Association concerning successful hay storage. By following these guidelines, the hay producer should obtain the best storage results and preserve high quality hay.

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Hay Storage Facilities

The selection of the hay storage structure depends entirely on the needs of the producer. It could be used for commercial hay storage, for future cattle feeding next to a barn or potentially used as a machinery or grain storage.

It should be remembered that many building plans exist and are available from the Canada Plan Service. There are three general types of storage: (1) all open walls, (2) open-front with 3 solid walls; and (3) all enclosed.

Storage without walls (Western Canada): This storage type could be used for hay fed to cattle on-site ([Figure 1](#)). However, it is not recommended for high quality commercial hay because of discoloration in the first rows of bales. Consequently, this lowers the price because sorting is necessary prior to transport.

Figure 1. Hay storage without walls.

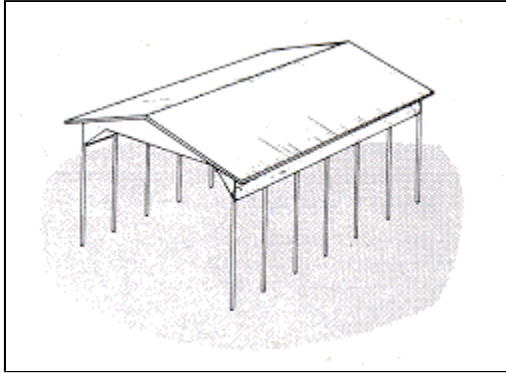
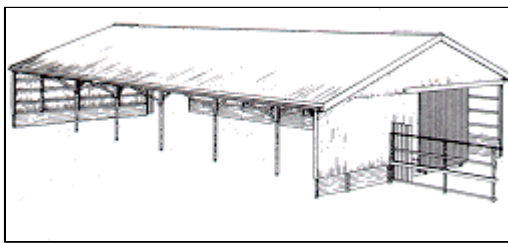


Figure 2. Hay storage with three solid walls and open-front that can be closed with a curtain.



Hay storage with 3 solid walls and open-front to be closed with a curtain: This type of storage has three solid walls with an open-front which can be easily closed with curtains or doors ([Figure 2](#)). The three solid walls can be made of curtain material used for covering hay, spaced vertical wood planks or siding metal. The open-front must be closed during the storage period. Movable sections of curtains could be used to create multiple access doors.

This storage type is recommended for many reasons: (1) hay loading can be entirely mechanized, (2) hay can be sorted and stored in sections according to quality, (3) it is easily accessible to buyers, and (4) there is no space lost to a traffic alley.

The open-front of the building must be oriented toward the south or southeast to reduce snow and wind problems.

Hay storage with solid walls and large off-centre doors This storage facility is very similar to a machinery shed ([Figure 3](#)). As shown in [Figure 4](#), the doors must be located off-centre to allow for traffic in the building and selection of hay according to the desired quality.

Figure 3. Hay storage with solid walls and off-center doors.

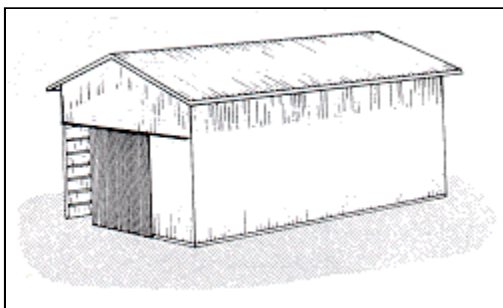
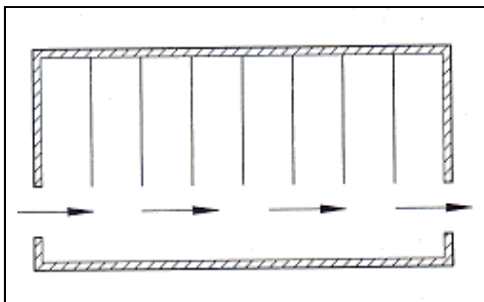


Figure 4. Schematic of traffic flow.



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Access

The location of the hay storage on the farm must provide good vehicle access throughout the year. Remember that hay transportation is done on 13.7 m (45') long trucks. An area free of objects measuring 22.9 to 38.1 m (75 to 125') around the loading zone is helpful for manoeuvring vehicles. The access road must be solid.

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Floor

When hay is stored directly on earth, gravel or concrete, frequently the bottom row of bales is damaged by dampness and, consequently, cannot be sold. There are 3 aspects to consider. First, there is upward moisture migration through the soil by capillary action. Floors made of sand and gravel can often get wet throughout the year. Second, even concrete floors with a vapour barrier beneath can get wet. At the end of winter and during spring, large temperature fluctuations occur causing condensation on the cold concrete floor which can then soak into the hay. Third, at the end of winter and during the spring, there is a downward moisture migration inside the hay pile (same phenomenon as with grain). This moisture condenses on the floor and damages the bottom layer of bales.

In fact, there is only one good solution to prevent the loss of the bottom row of hay. The hay must be stored on a portable slatted floor and underslat ventilation has to be provided. Considering everything, the cost of a slatted floor is far less than a concrete floor.

The plans in [Figures 5](#) and [6](#) show a portable slatted floor and wall-mounted ventilators for hay storages. Wall mount-ed ventilators are recommended for storage wider than 10.2 m (30').

Figure 5. Profile showing the recommended floor, wall-mounted ventilator, air duct and portable (8' x 8') 2.4 x 2.4 m slatted floor section.

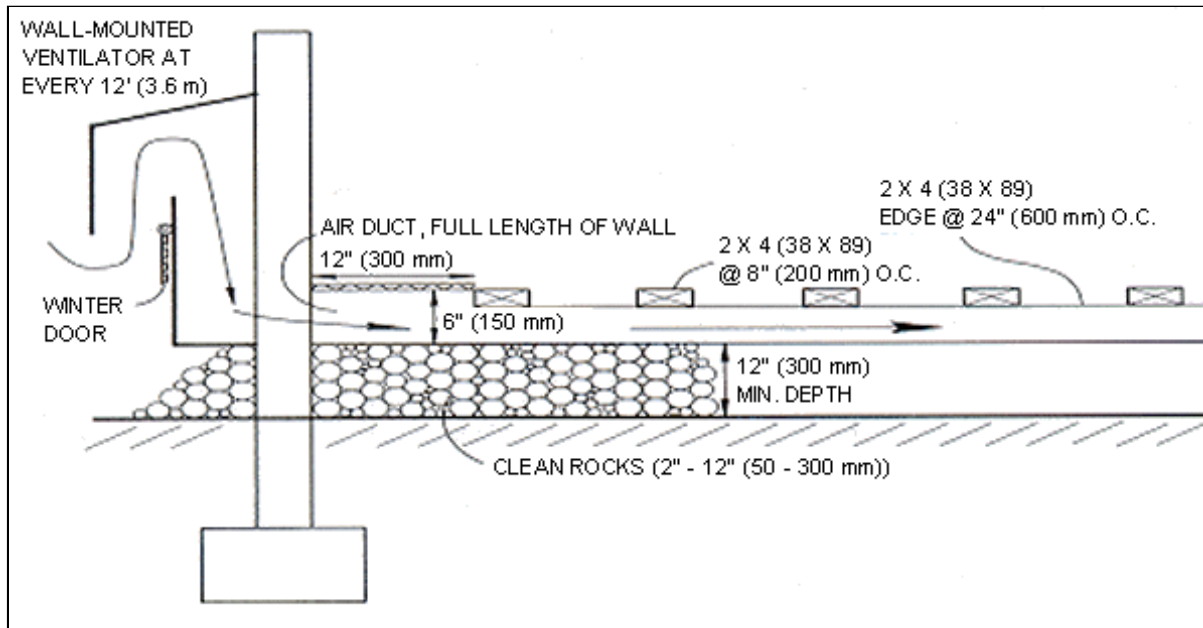
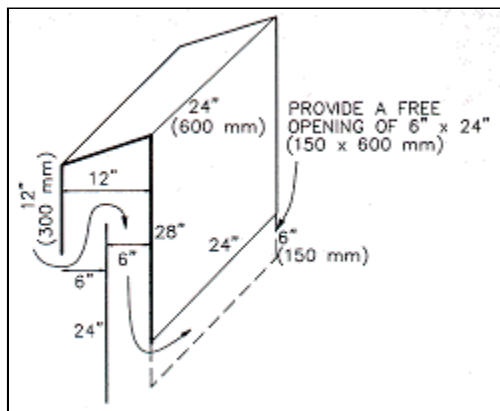


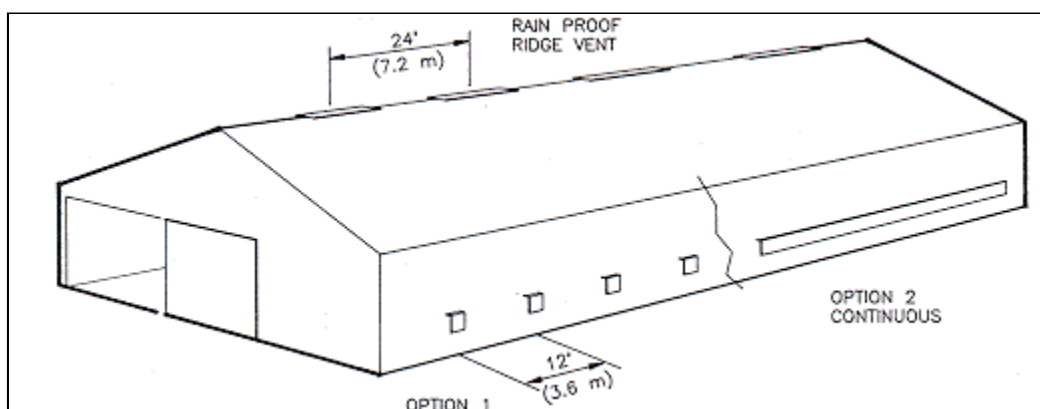
Figure 6. Wall-mounted ventilator.



There is little chance that snow can enter by the wall-mounted ventilators. However, it would be wise to close them during the winter.

Some producers will want to build a continuous wall ventilator or use another type of wall ventilator. However, it is recommended to use one wall-mounted ventilator every 3.6 m. [Figure 7](#) shows a typical installation of intermittent or continuous wall-mounted ventilators.

Figure 7. Hay storage with intermittent or continuous wall-mounted ventilators.



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Building Dimensions

The following recommendations concerning the building width and wall height are based on using a tractor to handle bales, and loading a 13.7 m (45') long truck to a maximum 4.3 m (14') height:

Minimum width: 12.2 m (40')
 Recommended width: 13.7 to 15.2 m (45' to 50')
 Length: according to user's needs
 Wall height: 5.5 m (18')

A height of 5.5 m (18') is ideal for small square bales handled with either a front end-loader or by hand, round bales stacked vertically, and big square bales.

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Wall Cladding

There are three main types of wall cladding for hay storage: (1) metal, (2) spaced wood boards, and (3) plastic curtains.

Metal is a very popular cladding material for machinery sheds and numerous other buildings. It gives a nice appearance and it is easy to install. With hay storages though, there are frequent condensation problems, usually on the north and west walls due to rapid weather changes.

The use of spaced wooden boards is becoming more popular. The main advantage is that air circulates through and along the walls, and the cost is reasonable. The construction method is simple. The boards are erected vertically and after drying, small 2.5 to 3.2 mm (1/10" to 1/8") cracks will develop between the boards. It is possible that some snow may infiltrate, and some sunlight may pass through but overall, there will be little damage to the hay.

The new plastic curtains used for covering hay piles or for animal shelters are an excellent cladding material. The obvious advantages are its low price and versatility for building access. Curtain sections can be opened easily to serve as doors for truck loading. The curtain must be solidly fastened to the building walls (eave, post and footing).

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Vertical Interior Finish

It is recommended to keep a 300 mm (12") clear space between the walls and the hay.

During drying, the hay compacts downward and if some bales have been stacked tightly against the horizontal girts, the exterior metal cladding could be ripped off or the wall boards may be broken.

The types of buildings with potential problems are the post frame and metal truss buildings where the cladding is fastened to horizontal girts. It is strongly recommended to add a vertical liner inside the building. Vertical members such as 25 x 75 mm (1 x 3") with a 150 mm (6") space between could be installed for a height of 3.6 m (12'). This will help to prevent damage to the building from any vertical movements of the hay.

Buildings with stud walls or with a pole frame and plastic curtain cladding do not require a vertical interior liner.

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Doors

The doors should be high enough and wide enough to allow a 4.3 m (14') high loaded hay truck easily access:

Minimum height: 4.4 m (14'6")
 Recommended height: 4.9 m (16') ideal
 Width: 4.9 m (16')

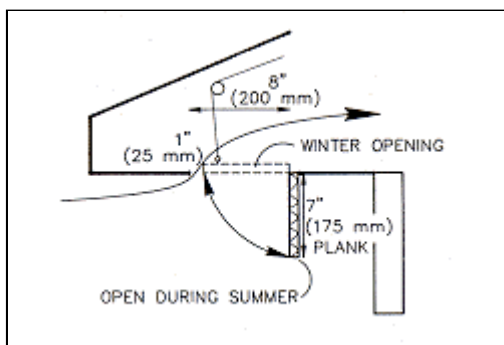
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Soffit

Ventilation above the hay is important all year round. During summer and fall, considerable amounts of hay moisture and heat from the sun have to be removed. On the other hand, during the winter and spring, building moisture has to be removed to prevent condensation on wall and roof cladding.

As shown in [Figure 8](#), the ideal case is to have a continuous soffit opening of 200 mm (8") for the summer which can be closed to 25 mm (1") continuous during the winter. A 300 mm (12") wide eave overhang is recommended.

Figure 8. Winter and summer continuous soffit opening.



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Ridge Opening

A continuous opening at the ridge level would be ideal, but unfortunately, there are no vented ridge caps which prevent rain or snow infiltration. Be very particular in selecting a vented ridge cap or ridge ventilator. When large soffit openings are used, ventilation by the ridge is far less important.

Recommendation: 1.2 m (48") ridge ventilator every 7.2 m (24')

Wind turbines can be used on the roof, however, they are more expensive than the common static vented ridge cap or ventilator.

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Lighting

The lighting level has to be sufficient and well distributed to adequately see the hay even when the hay is piled up to the trusses. Do not use transparent panels because the sun discolours the hay. Remember that hay buyers want to see the hay and their employees have to load the trucks safely.

Guidelines

Recommendations for building width 12.2 to 13.7 m (40 to 45'): 2 rows of incandescent lamps, (100 watts) spaced 4.6 to 6.1 m (15 to 20') apart.

Building width 13.7 to 16.8 m (45 to 55'): 3 rows of incandescent lamps, (100 watts) spaced 4.6 to 6.1 m (15 to 20') apart.

Please contact your Ontario Hydro representative for additional advice on lighting.

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Hay Storage Costs

There is the minimum cost for a basic structure to which the costs of options must be added. See [Table 1](#).

Table 1. Estimated costs (1992) for various hay storage alternatives

Description	Cost per square metre (Cost per square foot)		
	Stud frame	Steel frame	Pole frame
Basic Cost For the Structure with:			
Rocks or gravel floor, regular metal roof, 4 open sidewalls, 5.5 m (18') high	\$69.94 (\$6.50)	\$45.73 (\$4.25)	\$40.89 (\$3.80)
Options:			
1 - 3 walls with curtains, open-front with curtain doors	+\$4.30 (+\$0.40)		
2 - 3 walls with wood boards, open-front with curtain doors	+\$8.10 (+\$0.75)		
3 - 3 walls with metal siding, open-front with curtain doors	+\$10.75 (+\$1.00)		
4 - 4 walls with metal siding and 2 large doors	+\$22.00 (+\$2.05)		
5 - wooden slatted floor with wall-mounted ventilators	+\$16.15 (+\$1.50)		

6 - Simple electrical service (lighting)	+\$3.75 (+\$0.35)
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Note: \$/square metre = \$/square foot x 10.76

For example, a hay storage with pole frame, 3 walls, metal siding and open front with curtains, good lighting and a wooden slatted floor would cost \$71.54 per square metre (\$6.65 per square foot).

Options	Cost per square metre	Cost per square foot
Basic cost for pole frame	\$40.89	\$3.80
3 Walls and curtain front	\$10.75	\$1.00
Slatted floor	\$16.15	\$1.50
Lighting	\$ 3.75	\$.35
Total	\$71.54	\$6.65

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For more information:

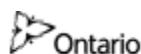
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