Farm Structures
FACTSHEET

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PLANNING A HAY STORAGE

This factsheet outlines the essential considerations in planning a hay storage: location and site preparation, sizing the storage, structural requirements and typical costs.

LOCATION AND SITE PREPARATION

Two suitable locations for hay storage are in the field near the harvesting sites or in the farmstead yard near the feeding location. Regardless of location, the building site should be shaped and built up so that runoff will drain away. (See **Figure 1**)

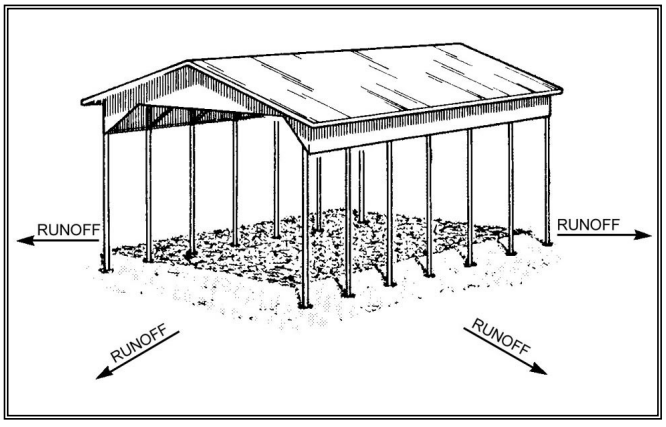

Figure 1 Well Drained Hay Shed Location

GRADING THE HAY SHED FLOOR

The floor of the hay shed may be graded to slope towards the centre of the floor. This can help prevent stacked hay bales from tipping out. Otherwise, if the hay shed floor slopes end-to-end or side-to-side, start stacking from the lower end or side against a backstop made of poles. This backstop can be placed at one end of the short barn or across the middle of a long barn. Accessibility to the barn should be provided from both sides.

SIZING THE STORAGE

Consider the following factors in selecting the size of the hay storage:

- volume and tonnage of hay to be storage.
- the type of haying system that is to be used, e.g. round bales, conventional square bales, large square bales or stacks.
- the equipment that will be used to place the feed into storage, e.g. bale wagon, stack mover, front-end loader, spike front-end loader stacker, etc.
- stacking pattern of the bales in the storage.

Based on all the above factors, the width, height and length of the building can be determined. Check with your equipment supplier or measure your machine to determine your requirements. Plan for future equipment purchases by allowing an extra 2 feet of width.

The type of bale and stacking pattern determines the tonnage of hay stored per square foot of barn. **Table 1** provides a guide for sizing the hay storage. Note that there is a considerable range of bale densities due to variations in crop, moisture content and effectiveness of the baler. Unless you weigh your hay in or out of storage, use the median figures tabulated.

Table 1 **Typical Bulk Densities of Hay Bales**

Bale Type	Bulk Density (lbs/ft3)	Storage Volume (ft3/ton)
Conventional Bales		
– Grass	8	250
– Alfalfa	14 (Range 11 – 16)	140
Round Bales		
– Grass	7	285
– Alfalfa	12 (Range 7 – 14)	170

RECTANGULAR BALES

Table 2 shows hay shed sizing for two conventional bale stacking wagons. An example of how to use the table follows:

A rancher in the Kamloops area requires storage for a 165 to 175 ton alfalfa crop. He also is going to purchase a new stack wagon to suit the storage. What are his choices?

Both wagon models stacking any of the bale sizes can be used but different barn dimensions are required. One possibility is the NH 1036, stacking 4 stacks wide in a barn 34.5 ft. x 96 ft long (16” x 18” x 46” bale – 175 tons).

Note that if stack retriever units are used to unload the storage, add 6” of width for each stack row. This additional 6 inches provide a full 12” clear between each stack.

Most hay storages have a pole spacing of 8 or 12 feet. The length of the hay barn should be a multiple of the pole spacing (i.e., 96 feet long rather than 100 ft).

Table 2

Two Conventional Bale Wagons Showing Required Barn Widths and Heights

Wagon Model and Bale Size	Minimum Clearance Height (ft)	No. of Stacks Across Barn	Minimum Barn Width (ft)	Tons of Alfalfa Per Stack Row	Capacity in Tons For Barn Lengths 48	72	96 (ft)
New Holland 1036 (2 bale high stack/7bale high stack)							
14" x 18" x 42" bale	15	3	25	7.8	62	94	116
(69 bales/stack)		4	32.5	10.4	83	125	155
Average bale Alfalfa 75 lbs		5	40	13.0	104	156	194
16" x 18" x 46" bale	14	3	26.5	8.3	66	100	132
(55 bales/stack)		4	34.5	11.0	88	132	<u>175</u>
Average bale alfalfa 100 lbs		5	42.5	13.8	110	166	220
New Holland 1037 (3 bale wide/7 bale wide stack)							
14" x 18" x 42" bale	15	2	24	7.3	58	88	117
(104 bales per stack)		3	35	11.0	88	132	176
Average bale Alfalfa 70 lbs		4	46	14.6	117	175	234
16" x 18" x 42" bale	14	2	24	7.5	60	90	120
(83 bales per stack)		3	35	11.2	90	134	179
Average bale Alfalfa 90 lbs		4	46	15.0	120	180	240

NOTE

1. Minimum barn width is **inside to inside** of poles.

2. Stored capacities are stacked tonnage. Hand filling on top of the stacks will increase the capacity.

   i.e. – Height of the stack at 7 bales high is approximately 10.5 feet.

   – For a barn clearance height of 15 ft, 3 ft or 2 bales high, can be hand stacked to increase tonnage by approximately 25%. For barn heights of more than 15 ft (typical plans allow up to 19 ft) greater tonnage per square ft can be stored.

3. **<u>Underlined</u>** number refers to example 1 – machine stacked only.

ROUND BALES

Table 3 and **4** can be used to estimate the hay barn size for round bale stacking systems. Only a few of the common round baler sizes are tabulated. Check with the dealer for more detailed information on your particular baler and bale size.

To maximize hay shed storage capacity, stack the first layer of bales on end with the next layers placed horizontally. Do not stack the bales against the side-walls or poles of the hay barn. The framing, poles and trusses are not designed to withstand the force of bales piled or tumbled against them. To prevent bales slipping out of the storage, install the horizontal rails between the poles as shown on Plan 7601

Table 3 — **Typical Round Balers**

HESSTON

Model	Bale Size	Bale Weight
5510	*60 x 60	**1200
5530	40 x 54	650
5540	48 x 72	1350
5580	60 x 72	1700

JOHN DEERE

Model	Bale Size	Bale Weight
330	46 x 48	575
430	47 x 72	1325
530	62 x 72	1750

MASSEY FERGUSON

Model	Bale Size	Bale Weight
634	36 x 60	700
640/1440/1445	48 x 60	950
1550/1565	60 x 721	700

NEW HOLLAND

Model	Bale Size	Bale Weight
848	48 x 54	750
853	57 x 60	1100
855	66 x 66	1550

* Bale size in inches; width x diameter.
** Bale weight in lbs. (based on alfalfa hay at 12 lbs/ft^3).

TYPICAL COST TO CONSTRUCT A HAY STORAGE

The cost of a structure can vary greatly depending on the site preparation requirements, local supplies, material used, manpower costs and construction techniques used.

A typical 40 ft wide x 152 ft long x 19 ft high structure would involve the following costs:

Site Preparation:	$ 1,520	or	$0.25/$ft^2$
Materials:	$12,160	or	$2.00/$ft^2$
Labour:	$ 7,600	or	$1.25/ ft^2
Total:	$21,280	or	$3.50/ ft^2

Table 4

Examples of Barn Widths and Heights with Stored Capacities and Stacking Patterns for Barn Lengths of 48 ft - Round Bales

Bale Dia. (in) Stack Pattern	Barn Width (ft)	Bale Width (in)	No. of Bales Stored	Approx. Capacity (t) (Alfalfa)	Minimum Barn Height (ft) by Bale Size
48	38				
Row 1-9 bales		46	396	114	17
Row 2-9 bales					
Row 3-8 bales					
Row 4-7 bales					
54	38				
Row 1-8 bales		40	374	122	15.5
Row 2-8 bales		48	332	125	17.5
Row 3-7 bales					
Row 4-6 bales					
60	37				
Row 1-7 bales		36	351	123	15
Row 2-7 bales		48	279	132	18
Row 3-6 bales		57	193	106	16
Row 4-5 bales		60	180	108	16
66	40.5				
Row 1-7 bales		66	160	124	17.5
Row 2-7 bales					
Row 3-6 bales					
72	38				
Row 1-6 bales		48	180	122	15.5
Row 2-6 bales		60	147	125	17
Row 3-5 bales		62	147	129	17

NOTES

1. Other capacities for barns other than 48 ft long: Barn lengths of 72 ft (x 1.5) and 96 ft (x2) etc.
2. Actual bale weight will vary (based on density of 12 lbs/ft^3).
3. Stacking pattern is first row standing on end; other rows lying on side.
4. Barn width includes 1 ft clearance each side of stack.
5. Minimum height allows for 20% slump in rows 2 to 4 plus 3 ft clearance. i.e.: 46 x 48 bale size has row 1 - 46” high plus 0.8 x (48+48+48) plus 3 ft which equals 17 ft.

STRUCTURAL REQUIREMENTS OF THE HAY STORAGE

Engineering drawings should be prepared and followed when constructing new facilities. **Figure 2** shows many critical points to which special attention must be given, amongst others, these are:

- Footings under poles should be of adequate size and thickness (8" x 18" diameter unreinforced concrete is typical for medium-strength soils). There is so little bearing surface area under a pole that the poles can sink if there is no footing.
- Posts shall be of adequate size and properly pressure treated. Use CCA (green or yellow) in preference to PCP (brown-black) treatment.
- Properly anchor the posts in concrete to protect against wind uplift.
- Trusses shall be sized and built to withstand the regional maximum snowloads. The building department of your municipality or regional district can advise you as to the ground snowload for your area. For a high structure such as a hay shelter, provided it is in an open, wind-swept location, it is permissible to take 60% of ground snow load for the roof live-load. The deadload for a truss roof with purlins and sheet metal is 5 pounds per square foot (psf). For example, if the ground snow load is 50 psf, the roof live-load is 50 x 0.60 = 30 psf. Roof dead-load is 5 psf. Total roof load is 30 + 5 = 35 psf.
- Truss anchors must be installed to prevent negative wind-load uplift.
- Brace the trusses and the truss webs that are under compression. Follow the bracing details provided in your plan. The truss fabricator should supply you with a diagram showing where to brace the trusses.
- Install diagonal bracing for roof stiffness.
- Properly sized and installed truss support beams are required.
- Knee braces and wind braces must be properly sized and secured. Knee braces do affect the clearance available but it is not usually a problem if you build the structure high enough. Knee braces are essential to provide lateral stability against wind-loads.
- Use adequate lumber grades and proper nail sizes.
- A short perimeter skirt extending 4 feet below the eaves conceals the knee bracing, helps to control longitudinal sway and reduces wetting of the bales by blowing rain and snow.

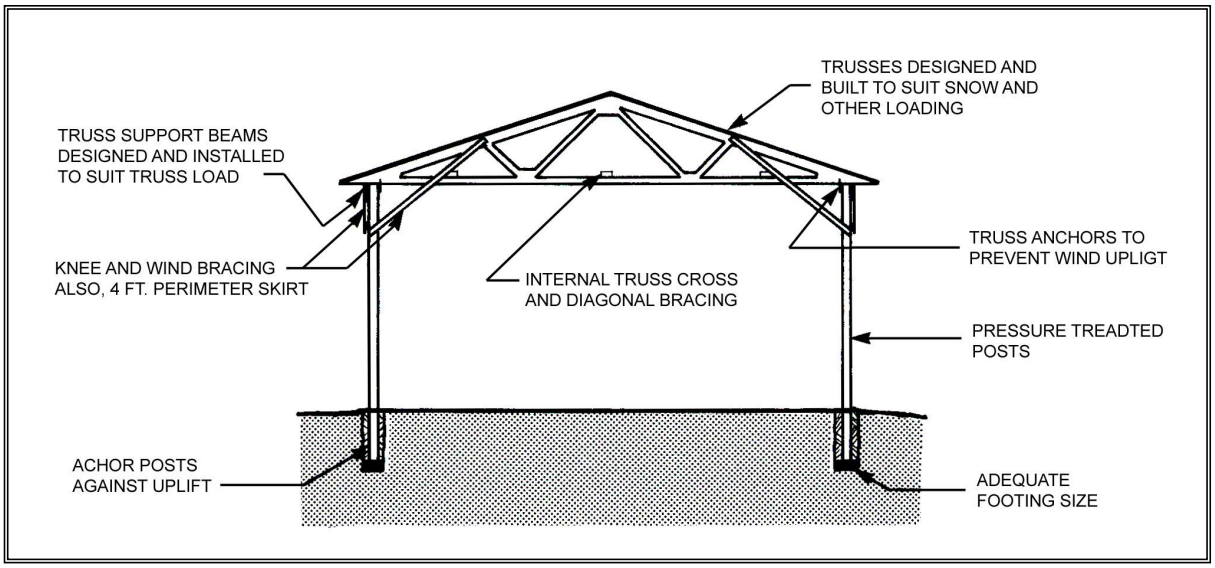

Figure 2 Hay Shed Structural Requirements

FOR FURTHER INFORMATION CONTACT
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