

Heavy Snow Loads

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The recent accumulation of snow in many areas throughout New York state has caused some agricultural buildings to fail. Failure can be the result of several items linked to the snow load present on the building. These items include but are not limited to:

- Improper building design
- Improper building construction
- Actual snow load exceeds design snow load
- Imbalance of snow load on roof
- Failure of one key member causing others to fail as a result of load transfer (domino effect)

Pre-engineered post frame agricultural buildings are designed to withstand a certain level of wind and snow loading and should withstand any snow loads that are below the "design value". For example, if the given snow load is 30 lbs. per square foot acting on the building and it was designed for a design load of 40 lbs. per square foot, then there should be no load carrying problem. Unfortunately, there are agricultural buildings out there that have not been designed for any particular loading at all. These building have a much higher probability of failing as a result of the current snow accumulations we are seeing.

So, how do we know if a building is going to fail? For a pre-engineered building, we can check the actual snow load on the building against the design snow load. If the actual load is less than the design load, then failure is not eminent. Table 1 can be used as a guide to estimate the snow load on a barn. Compare the table value against the design value to see where you stand. The table cannot be used for a non-engineered structure.

Wood structures will show stress before they fail unlike metal structures that usually will not. For a wood structure, the following audible and or visual signs may be noticed prior to failure:

- Creaking or moaning in the building
- Bowing of truss bottom chords or web members
- Bowing of rafters or purlins
- Bowing of headers or columns

Table 1. Snow Load Based on Accumulation Depth

Snow Depth on Roof (Ft.)	"Dry Snow" (lbs./sq.ft.)	"In Between Snow" (lbs/sq. ft.)	"Wet Snow" (lbs./sq. ft.)
1	3	12	21
2	6.5	24	42
3	9.5	36	62
4	12.5	48	83
5	15.5	60	104

If these signs are present, consideration may be given to evacuating animals from the barn and it is certainly recommended to evacuate all humans from the structure.

One option commonly considered to relieve loading from the barn is to shovel the roof. Experienced individuals who are properly trained and protected should only do this. ***Attempting to save a barn is not worth risking lives over.*** Shoveling the roof without the proper approach may actually cause more damage than good by creating an unbalanced load on the roof.



Do's and Don'ts for Barn Snow Removal

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Removal of significant snow accumulations off of a barn roof is best performed in a systematic way to reduce the risk of injury or death to both barn occupants and those working on the roof. Removing roof snow without a proper approach may actually cause more damage than if left alone in some cases by creating an unbalanced and/or concentrated roof loads.

The recent Upstate New York lake effect snow storms have dumped feet of snow causing many barns to be in danger of failure. The forecasted rain events for the next few days, along with warming temperatures will increase the weight of the current snow on barn roofs, thus further increasing the risk of barn failure.

Before accessing a barn roof, first assess the barn's current structural situation. **Wood** frame structures generally will provide clues that failure is imminent before they fail. For a wood structure, the some or all of the following audible and/or visual signs may be noticed prior to failure:

- Creaking or moaning in the building
- Bowing of truss bottom chords or compression web members
- Bowing of rafters or purlins
- Bowing of headers or columns

Note: For pre-engineered **metal** structures, the above list does not apply, as these structures will more likely fail without warning.

If any of the above items are observed, then careful assessment of the situation is needed. Consider removing cows from the barn, if possible, using cab tractors and skid loaders to provide workers some level of safety. *If in doubt, do not enter the barn or go on the roof.*

Farms that do decide to remove snow from barn roofs must be very aware of the dangers that are present and refrain from becoming complacent after working hours on end removing snow. Below are some recommendations for removing snow from barn roofs in the form of Do's and Don'ts.

Do's

The best way to remove roof snow is by using a systematic, zone removal, approach. A barn with a substantial snow load is shown in Figure 1; the number of zones depends on the width of the barn or the span of the trusses, but in all cases, the snow removal starts with the eave areas as shown in Figure 2. Remove snow from both sides of the barn as equally as possible as shown in Figure 3. As snow is removed from the roof, also be sure to remove snow away from the barn sidewalls as deep snow piled against the walls may cause barn failure and ventilation challenges. Continue working towards the roof peak, removing snow in a systematic and balanced approach as shown in Figure 4 until all snow is removed as shown in Figure 5.

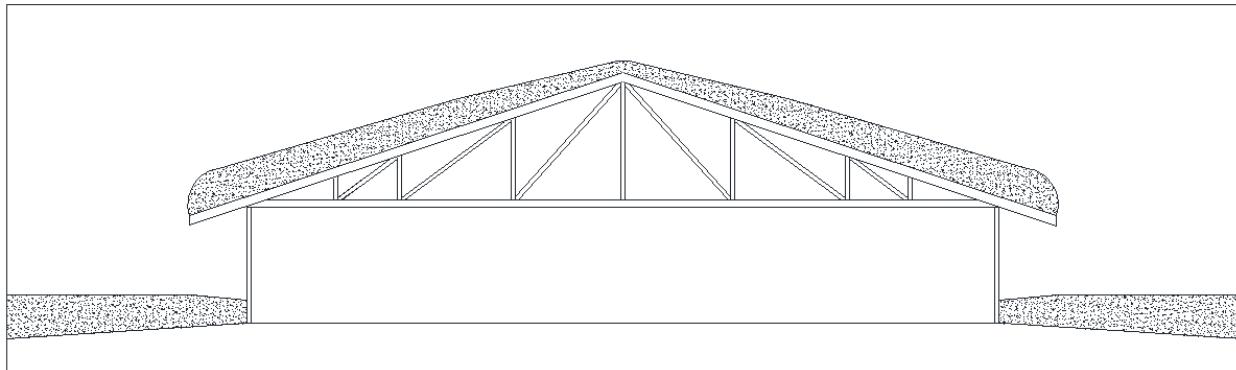


Figure 1. Barn with substantial snow load.

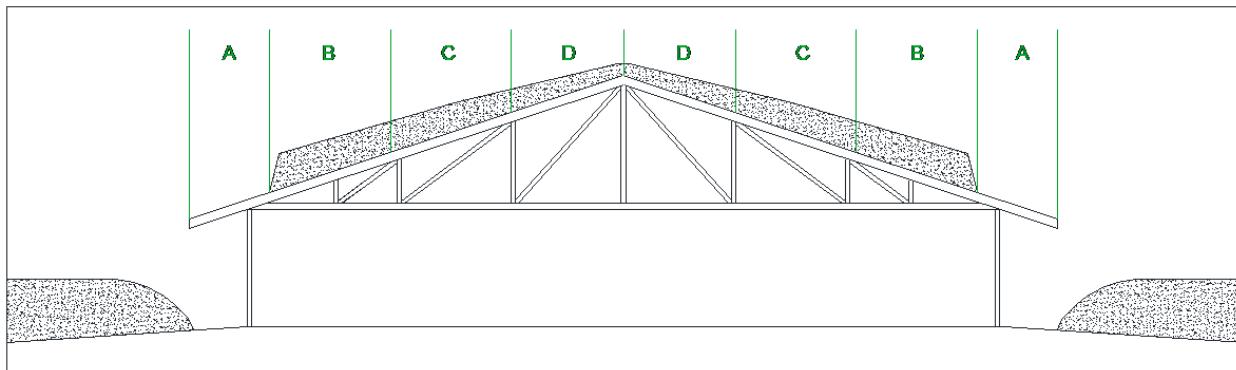


Figure 2. Remove snow from Zone A on both sides of the barn. It is important to keep the loads symmetrical on each truss.

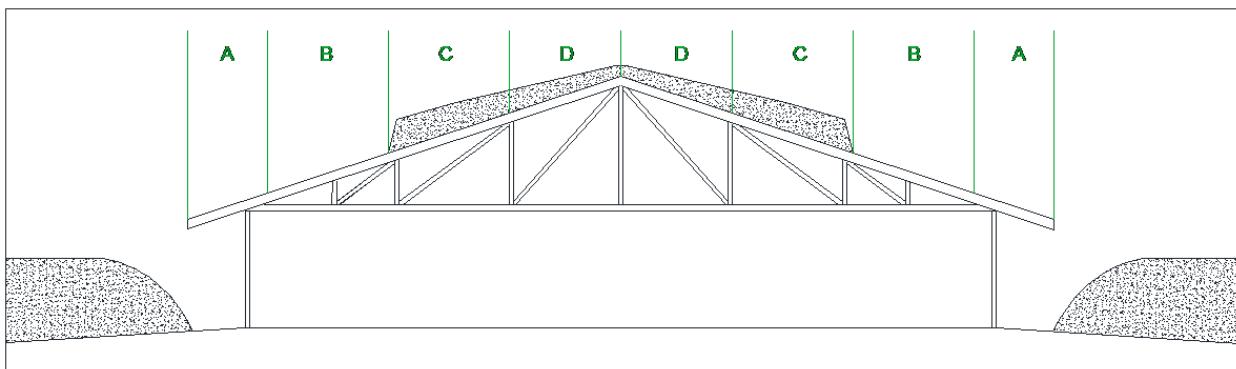


Figure 3. Move snow from Zone B down to Zone A and then off of the roof. Make sure to keep the snow on the ground off the sides of the barn. The posts, siding, and /or curtains are not designed to handle this type of load.

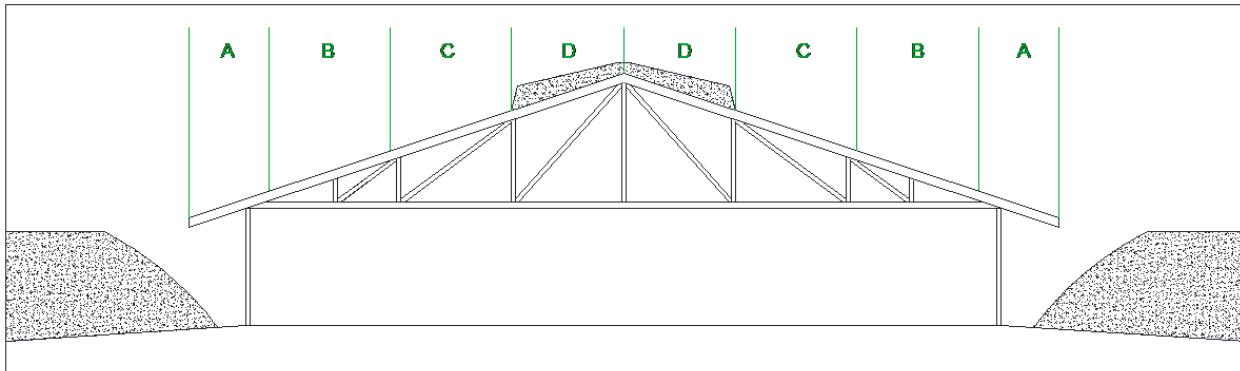


Figure 4. Move snow from Zone C down to Zones B and A, and then off of the barn and continue to remove snow away from barn sidewalls.

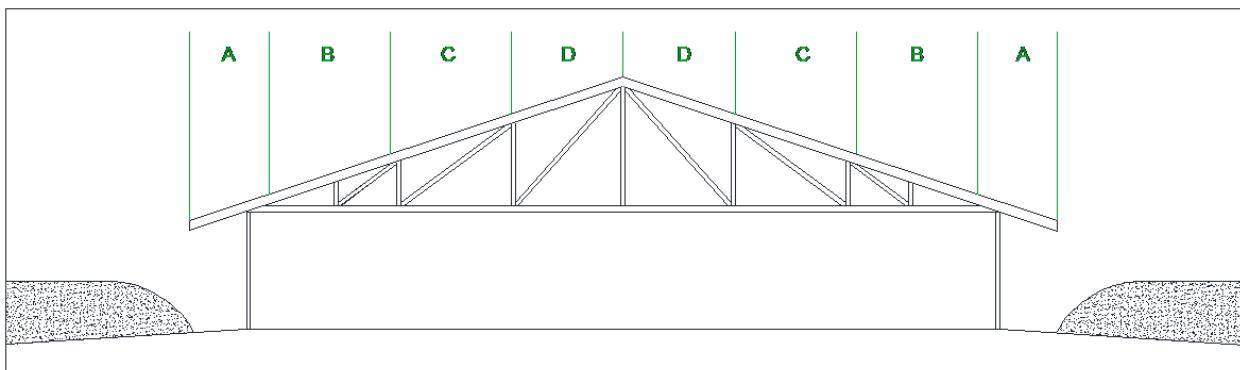


Figure 5. Snow fully removed from roof and away from barn sidewalls.



Don't:

- Remove snow unequally from a barn roof (Figure 6). Unbalanced loads can cause the unloaded side of a truss to lift, possibly compromising the connection at the post. Rather, work back and forth from side to side as you remove snow, or a crew on each side simultaneously if possible.
- Pile large piles of moved snow atop the roof (Figures 7 and 8.). A structure may be able to support a snow load when it is spread equally across, but once loads are combined over smaller portions of the roof, failure may occur in those areas. Remove snow gradually from the roof to the ground, starting with lower zones and working up to the peak as outlined above.

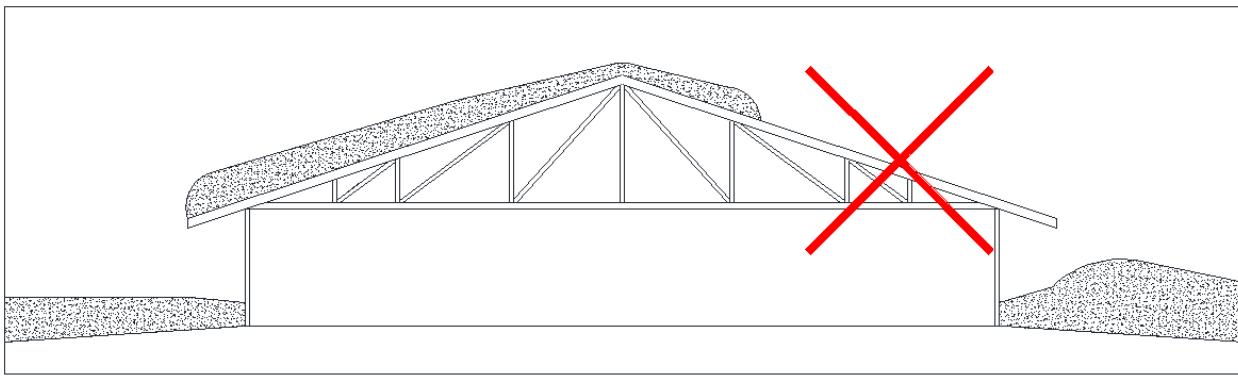


Figure 6. Roof snow load removed in an inappropriate manner – unbalanced unloading.

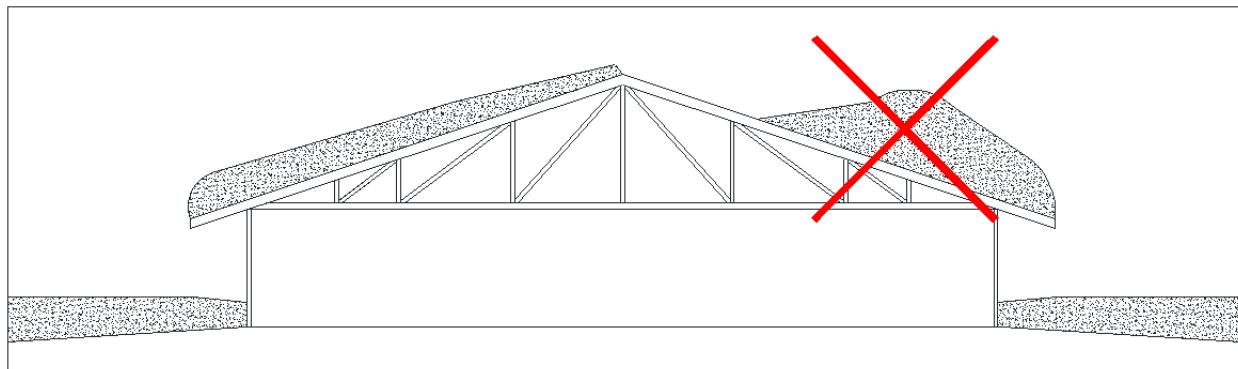


Figure 7. Roof snow load removed in an inappropriate manner – concentrated and unbalanced unloading.



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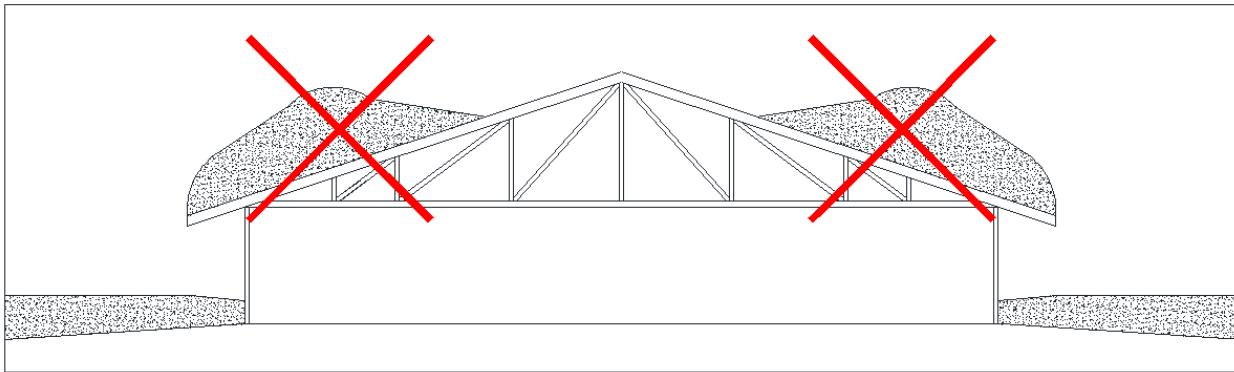


Figure 8. Roof snow load removed in an inappropriate manner – concentrated unloading.