UCONN | COLLEGE OF AGRICULTURE, HEALTH AND NATURAL RESOURCES
EXTENSION

Storm Preparedness Series

Reducing Storm Damage to Your Barn

Buildings need to provide a safe environment for workers and animals. Historically, agricultural buildings were considered of "low importance," so structural load reductions of roughly 20 percent may have been applied in the design. If there were no engineered building prints or structural inspections, the owner assumed responsibility for building design.

Today, weather event data, along with storm and load frequency, is needed to develop worst-case scenarios during a structure's life expectancy. Low, medium, and high importance design values consider 25-, 50-, and 100-year storm recurrence, respectively.

Structural Components
While no building can be said to be wind or snow proof, these tips will significantly reinforce old as well as newer barns. Structural integrity of a building is the sum of its components. The weakest component determines the overall strength of the system.

The building materials selected need to be resistant to the shelter environment. Moisture, manure, urine, bedding, and feedstuffs require careful attention to ventilation design. Leaky roofs or moisture from animals results in rotten wood or metal connections. Condensation results from warm moist inside air hitting a cold outside surface, releasing the moisture.

Inspect buried pressure treated posts at the ground line. If not preserved adequately, failure in posts after 20-30 years is becoming more common.

Fasteners and Connections
The next biggest problem is in the area of connections. Simply adding a few more nails could weaken connections. Bolts are often required in post frame construction to resist lateral (shear) loads.

Jay Harmon, Extension Livestock Housing Specialist, Iowa State, has seen failures due to roofing pulled up by the wind. Suction is greatest at the corners and edges of the roof so those areas should have more fasteners than other parts of the roof.

Plate line weakness is another critical area mentioned. It causes greater damage than any other point. The cause of the weakness is the tie between the rafter system or truss and the top plate. In raftered roofs, inadequate nailing of the ceiling joists and rafters results in a weak joint. In addition to proper nailing, the use of galvanized 18-gauge truss fasteners provides additional protection from failure.

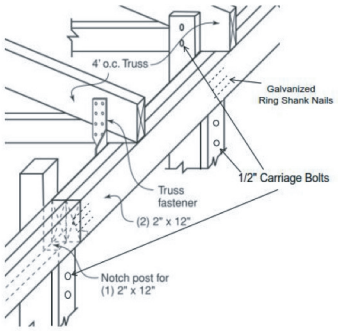
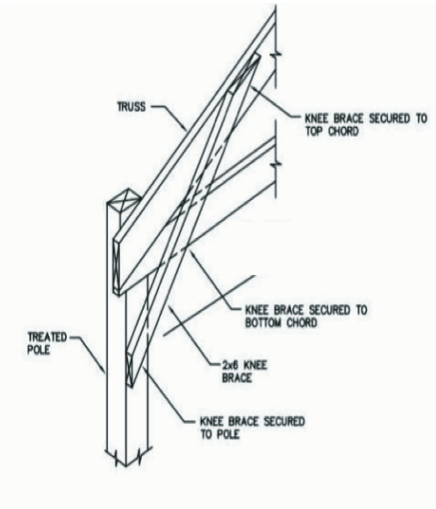


Image courtesy of Simpson Strong-Tie (H2.5AZ)

Corner Bracing
James Scarborough, Engineering Professor Emeritus, University of Delaware, offered the following suggestions. "Corner failures occur with both frame and pole construction during high wind events. Adding a wind brace at each corner will add rigidity to a framed barn. In pole frame buildings, wind bracing is also required, usually in the form of X or V bracing at the corners. This should be along the building length for maximum strength.

Roof Bracing

Nearly half of storm-damaged barns are not designed to handle the snow load or wind speeds due to inadequate roof bracing.



In pole frame construction, the one thing that can substantially help reinforce the roof system at the plate line is the addition of "knee" braces, every eight feet. Although they can be a bit of a nuisance when maneuvering machinery around, they more than make up for it in the additional lateral strength they impart to a building, especially in open barns. To make them, use 2X6's, five to six feet long and set at a 45-degree angle. Nail to the post and truss, with 30d nails, preferably nailing to both the upper and lower chords. To make a raftered roof strong, simply make it like a truss. To do this, add a collar beam to tie in the upper ends of the rafters. Make this out of 1X6 or 1X8 rough lumber and nail to the rafters with 10d nails, which are clinched over. This quick and inexpensive fix will add greatly to the strength of the entire roof system."

Many newer wood frame barns have inadequate roof bracing from the truss to truss. Drifting or sliding snow creates unbalanced or excess loads. Failure of one key member causes others to fail because of load transfer (domino effect). Proper lateral, diagonal, and web truss bracing is essential. Diagonal "gabel" or cross-bracing 2X4's are nailed every three trusses. A double set of X-bracing should be used every 20'-40'.

New York Barn Review

A series of winter storm events during January 1999 resulted in significant accumulations of precipitation in many areas of New York State. Several agricultural buildings failed because of the snow load, many of which were built using post-frame construction. A field observation was conducted with the objective of evaluating why the buildings failed. For buildings that had been partially or fully repaired or replaced, an evaluation of the new building was made. Cornell University researchers evaluated seven buildings. Most of the trusses that failed and their replacements seemed to have inadequate bottom chord lateral bracing. In addition, they appeared to have inadequate diagonal bracing and truss-to-header connections. Comparatively few industrial, commercial, or residential buildings failed during this same period.

Insurance

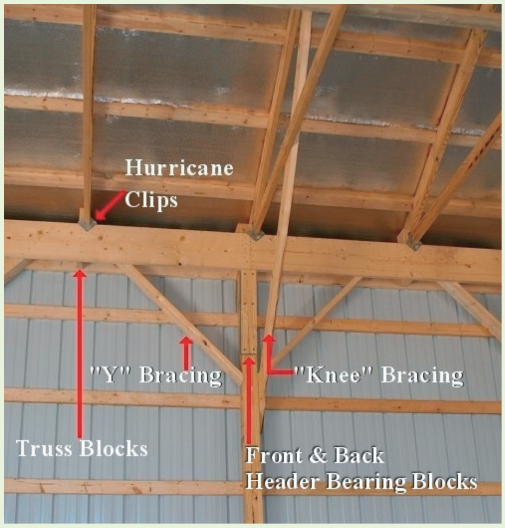
If building a new barn, talk to your insurance company first. Is 'snow load damage' covered for actual barn replacement costs? Is equipment and animals inside the barn covered under the farm personal property endorsement?

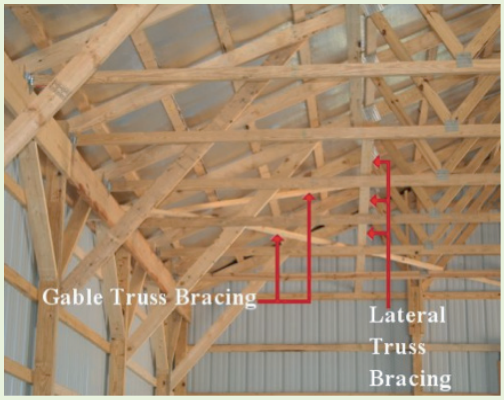
Conclusion

Just because your building made it through last winter does not mean it can take another beating. A visual inspection will go a long way. Walk through with an experienced builder or structural engineer to examine the connections and roof braces.

By Joyce Meader, UConn Extension Dairy/Livestock Educator
2018

Visit www.eden.uconn.edu for more information about storm preparedness.





Annual checklist:

- Look for headers coming away from a post.
- Make sure trusses, rafters, headers and columns are not bowing or twisting.
- Is the bracing installed and still intact?
- Is the wood split around nails or bolts?
- Do you hear creaking or moaning?
- Are foundation bolts missing?

References:
MWPS-72008 Braced Rafters for 32'-36' Barns
http://www.public.iastate.edu/~mwps_dis/mwps_web/plans/72008.pdf

Gooch, Curt A. Heavy Snow Loads, Cornell University Extension (Table 1: Snow Load)

Gooch, Curt A. and K.G. Gebremedhin. Assessment of Failures of Post-Frame Buildings in New York Cornell University 1999

"Post-Frame Building Handbook NRAES-1"
https://books.google.com/books/about/Post_Frame_Building_Handbook.html?id=yvZHAAAAYAAJ

Scarborough, James. Wind Resistant Construction, University of Delaware Extension