

# SURVEYING THE NATURE AND SCOPE OF FAILURES IN FARM BUILDINGS

Carl A. Duley  
Professor, UW-Madison Division of Extension  
Buffalo County Agricultural Agent



## Introduction:

I am a teacher, researcher, University Extension Professor, and a concerned citizen and supporter of farmers and rural life. I am not an engineer, a builder, or manufacturer. This is not intended to be a technical article; I will leave that to people who are qualified to publish the technical aspects of this issue. This article is intended to encourage a continuing discussion about the issue of farm structure failures and hopefully reach some solutions or steps to help prevent future failures.

Storm intensity seems to be increasing in Wisconsin including winter snowstorms. In the last 10 years, we have had numerous significant snow events that led to farm structure failures. I will concentrate on failures near my home office in Western Wisconsin, specifically in Buffalo County. Regional building failures in 2018-19 directly led to my involvement in conducting a building survey to study farm building failures.

I was invited to become involved with the Wisconsin Frame Builders Association (WFBA) Technical Committee by Aaron Halberg, Halberg Engineering, and Dr. David Bohnhoff, University of Wisconsin-Madison, both experts in post-frame design and with farm building failure investigation experience following heavy snow events in Wisconsin. The WFBA held a special meeting in the Spring of 2019 to discuss what happened that winter and why. Wisconsin, like many other agricultural states, does not require agricultural buildings to be

engineered or inspected (although some counties do have inspection requirements). This was a known issue, but could something be done to reduce farm building failures without creating a requirement for engineering and inspections?

## Changes Over Time:

Nothing has really changed since 2010 and millions of dollars have been lost and lives are being risked because many buildings are not designed adequately. Visiting with builders and engineers in Wisconsin it is apparent that this has been a problem for decades. Failures have been investigated by engineers and causes identified, but still, no solutions have been implemented. This study was intended to find solutions to this issue. Unfortunately, Covid got in the way of the individual interviews that are needed to accomplish all of the objectives.

## Situation:

Damage during the winter of 2009-10 was not widespread but rather limited to a narrow band in West Central Wisconsin. The snow was very wet and heavy with 10 -18 inches of new snow falling over an eight hour period, accompanied by winds blowing from the northwest at 30 -50 miles per hour. Eleven barns partially or totally collapsed in Buffalo County. These barns ranged from 9 months old to 30 years old.

2018-2019 brought heavy snows that accumulated on roofs. During February 2019, 45 inches of new snow fell, with high temperatures averaging



2009 Building Failure photo submitted by Dwayne Bundy

9 degrees below normal, low temperature average was 13 degrees below normal. The area had only two days above freezing in this stretch, February 3rd and 4th. On March 12th the area had 1.1 inches of rain adding weight to snow-covered roofs. (NOAA, Lock and Dam #4; Alma, WI) More than 100 farm structures failed in Buffalo County from March 12th to April 15th with an estimated financial loss of more than \$10,000,000. (STORM Disaster Reports, Buffalo County Farm Service Agency) The damage also spread beyond the county throughout the middle 1/3 of the state and had a severe economic and social impact on farmers in the region.

**Objectives of Study:**

- a. Determine the number of farms that experienced losses from farm building failures due to snow load.
- b. To determine the financial loss to farmers associated with farm building failures by comparing total financial loss with amount of financial loss covered by insurance.
- c. To assess the long-term durability of building materials in enclosed livestock environments (or high moisture environments?).
- d. Determine common characteristics of farm buildings failures and identify focus areas to reduce failures in current and future projects.

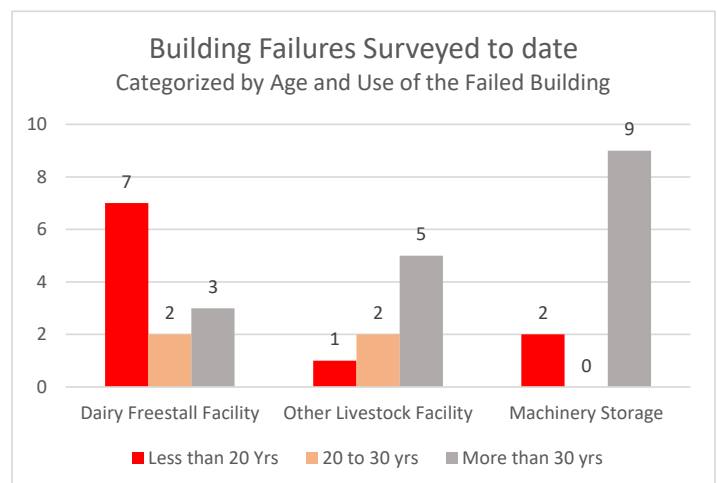
**Response:**

I met with the Wisconsin Frame Builders Association Technical committee and started discussions with Aaron Halberg of Halberg Engineering on what we needed to learn and what should be done to address the problem and prevent future failures. It became evident that information as to the extent of the problem was lacking, as was basic information on the characteristics of buildings that fail. A survey was

developed after receiving input from technical committee members of both the WFBA and the National Frame Building Association (NFBA), and distributed to farmers in Wisconsin through UW-Madison Division of Extension Agricultural Agents and through state media outlets.

**What has been learned so far:**

- 1. Insurance coverage for farm structures is much better in 2019 than in 2010. It appears that 2010 was a bit of a wakeup call for farmers. Many structures were not insured for snow load or were under insured (contents in the buildings may not have been insured) in 2010. Of the respondents in 2019/2020, only three structures were not covered for snow load failures and these were older facilities (built before 1970).
- 2. Age of the facility was not an overriding factor in building failures. This is especially evident in Livestock Facilities. Five of the livestock facilities reported were built in 2009 or later. (See Figure 1 and Table 1)



**Figure 1: Age of Farm Structures reported in the 2019-20 Survey**

continued on page: 20

continued from page: 19

3. Facility design appears to make a difference. Of the facility failures reported, only one reported the farm structure was designed by a structural engineer and included a plan with an engineer's stamp.

[See Table 1 on page 19](#)

4. Anecdotal evidence from one-on-one conversations and two group meetings indicated that lenders feel barn failures are an insurance issue. Insurance companies did not indicate that the losses were a major concern. Many farmers, lenders and insurance representatives assume (incorrectly) that if a quality builder is used for their project, the structure itself will be designed and certified by a structural engineer.

5. Safety Issues: To this point, there are few reports of injuries or deaths due to farm structural failures, however.

- In 2019, one farmer fell through a skylight on the barn roof while removing snow from the roof (to prevent a possible failure) and died from the fall.
- In 2010, a father and son, were injured and hospitalized when more than 50% of their barn collapsed due to unbalanced load on the roof. (Dr. David Bohnhoff determined it was progressive collapse due to poor design)
- 235 cows died or were euthanized in 2019 due to barn failures along with over 4,000 sows, in Buffalo County. Additionally, an undetermined number of livestock were culled prematurely due to injury.
- Modern livestock farms have people working in them many hours per day, increasing the risks that human injuries may result if farm structures fail.



### What can be Done?

In this section, I ask what can be done beyond regulating all farm structures.

#### Mandatory Structural Design:

I understand that requiring all farm structures to be reviewed and be designed by a structural design engineer would ultimately make structures safer, but at what cost? I have heard about delays in projects, high cost for reviews, lack of inspection or enforcement, etc. but maybe this is the only answer.

#### Incentive Programs:

Currently, there has been limited success using an incentive program to lower insurance premiums or improve financing terms for structurally engineered farm buildings. Such programs have been tried in Minnesota, but the practice does not appear to be gaining widespread adoption.

#### Questions begging for an Educated Response:

Many farmers assume their builders are using a structurally engineered design. They also assume a building is designed by a structural engineer if it is built with engineered trusses. These

**Table 1: Detail of Farm Structures Reported in 2019-20 Survey**

Facility Use	Year of Failure	Year Constructed	Designed By	Size (feet)	% Damage
Dairy Freestall Facilities	2010	2009	Builder	112 X 410	10
Dairy Freestall Facilities	2010	2017	Builder	84 X 300	
Dairy Freestall Facilities	2018	1998	Builder		50
Dairy Freestall Facilities	2019	2000	Builder	106 X 800	80
Dairy Freestall Facilities	2019	1990	Builder	100 X 320	5
Dairy Freestall Facilities	2019	1967	Builder	44 X 104	100
Dairy Freestall Facilities	2019	1980	Lumber Yard	70 X 200	50
Dairy Freestall Facilities	2019	2009	Builder	120 X 200	5
Dairy Freestall Facilities	2019	2004	Lumber Yard	104 X 184	30
Dairy Freestall Facilities	2019	1985	Lumber Yard	60 X 100	100
Dairy Freestall Facilities	2019	2015	Builder	108 X 510	25
Dairy Freestall Facilities	2019	2003	Builder	103 X 144	40
Other Livestock Facilities	2018	1986	Builder	20 X 60	100
Other Livestock Facilities*	2018	1985	Engineer	12 X 70	70
Other Livestock Facilities	2018	1955	Builder	40 X 90	25
Other Livestock Facilities	2019	1975	Lumber Yard	60 X 200	30
Other Livestock Facilities	2019	1995	Builder	23 X 72	20
Other Livestock Facilities	2019	2015	Builder	160 X 630	50
Other Livestock Facilities	2019	1994	Builder	50 X 65	80
Machine Storage Facility	2019	2015	Builder	60 X 120	80
Machine Storage Facility	2019	1975	Lumber Yard	45 X 80	80
Machine Storage Facility	2019	1979	Builder	30 X 60	80
Machine Storage Facility	2019	1974	Builder	54 X 105	2
Machine Storage Facility	2019	1979	Lumber Yard	55 X 160	50
Machine Storage Facility	2019		Lumber Yard	40 X 80	80
Machine Storage Facility	2019	1980	Lumber Yard	60 X 160	100
Machine Storage Facility	2019	1960	Lumber Yard	40 X 102	10
Machine Storage Facility	2019	1976	Lumber Yard	48 X 128	25
Machine Storage Facility**	2019	2015	Home Built	40 X 50	100
Machine Storage Facility	2019	1974	Lumber Yard	40 X 60	100
Machine Storage Facility	2019	1978	Lumber Yard	56 X 112	20

\*Only facility that was reported as being designed by an engineer

\*\*Fabric Structure

continued on page 22

continued from page: 21



Old Barn vs New Barns



and many other misunderstandings should be addressed to reduce future barn failures.

- How do farmers learn to understand the value of engineered structures and not just taking the low bid for a building?
- What is the additional cost of a properly engineered building versus one that is not (initial versus long term)?
- What is the reasonable lifespan for a structural designed farm building (30, 40 or 50 years)?
- Who should drive a statewide or national educational response and should farm buildings be treated like other commercial structures?

**RIGIDPLY RAFTERS**

WWW.RIGIDPLY.COM

**GLU-LAMINATED POSTS**

**Time-tested** successful in-ground preservative performance dating back more than **80 years**.

**Treatment occurs before gluing** for maximum penetration and protection.

Waterproof, structural glue **with a proven history of more than 150 years** - stronger than the wood itself.

701 E. Linden Street, Richland PA 17087  
**WWW.RIGIDPLY.COM**  
 717.866.6581

**Summary and Unresolved Questions**

Farmers cannot afford to re-build all existing buildings to bring their facilities up to current standards supported by engineering. Is it possible for existing buildings to be improved to meet current snow and wind loads? The need is related to climate change and increasing extreme weather events including wind, rain, and snow events. Is there a program the Frame Building Associations can implement to bring facilities up to a standard that meets the needs of 2021 and beyond? Is there a possibility for state or federal project funds to develop a farm structure improvement plan? Will insurance companies, agriculture lenders, and farm safety professionals all help in this effort?

Today, farm structures are occupied a greater percentage of time than they were 20 years ago. Many livestock barns now have people working inside of them 18 hours a day or more, thus raising the risk of personal injury should a failure occur. Owners have a responsibility of providing a safe environment for their families, their employees and themselves.

Farmers are inherently optimistic, if not, they would never plant a crop a year following a drought. We have already forgot about 2010 and 2019 and say it won't happen again. This may be too optimistic as the story of the person who fell off a 20-story building and was heard to say as they passed the eighth floor, "So far so good!" **It is time to make a change and be realistic about the issue of farm structural failures and the**

**increasing likelihood that building failures will lead to loss of life, in addition to continued financial losses apparently absorbed through the insurance industry.**

*About Carl Duley:*

*Carl Duley has served as Buffalo County's Agriculture Agent since 1985. He has recently been promoted to Professor. Crop Production and Management is his primary area of focus. Carl has provided leadership helping establish the Buffalo County Barley Society in 2014 where he continues to serve as local advisor today. His leadership roles in Extension include: the Dean's Faculty Tenure Advisory Committee; DALs Standards, Rank & Promotion Committee; and Chair of the Extension FARM Team Management Assessment Center.*

# BUILDING CONNECTIONS

East Coast Fasteners produces durable, long lasting fasteners for all combinations of building materials.

- Quick Ship Program
- Extended Warranties
- Colors to match any rollformed steel
- High quality products for any application

East Coast Fasteners...**Building Connections** for the construction industry.



**800.558.5895 • [www.plyco.com](http://www.plyco.com)**

**The FASTEST, SHARPEST, CLEANEST Drilling Fasteners Available!!**

Ply-Lo Extended • Ply-Lo Extreme • Ply-Lo Driller • Ply-Fast • Metalfast  
Stainless Steel • Ply-Lo Low Profile • Flashers • Closures • Wood Deck