



## Giving old barns new life

University of Wisconsin-Extension  
State Historical Society of Wisconsin  
Wisconsin Trust for Historic  
Preservation

# *Silos: an agricultural success story*

**Peggy Lee Beedle**

**M**any people would be surprised to know the same progressive spirit that characterizes Wisconsin's political history also colors its agricultural past—especially in the area of agricultural technology.

During the Progressive era, college agricultural experiment stations across the country promulgated scientific agriculture, or “book farming.” In Wisconsin, this movement focused on the development of an efficient method of storing winter fodder for the burgeoning dairy industry. Silos were the result. Silos allowed farmers to engage in year-round dairying, laying the groundwork for the state's thriving dairy industry.

Wisconsin has more silos than any other state, and they can rightly be viewed as symbols of the dairy industry's development. These structures chronicle the geographic range of Wisconsin dairying and graphically illustrate the changes in farm buildings over the years, serving as markers of the state's cultural heritage.

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**Barn and silo on a Vernon County farm.**

## Changes for farmers

In Wisconsin, the 1870s were a time of transition for farmers. Wheat had been the state's main crop from early settlement through the Civil War, but crop failures and open land in the West forced farmers to look for other ways to use their land. Many tried various cash crops and mixed farming.

The 1870s also saw the rise of the fledgling dairy industry. At that time, farmers generally considered dairying a seasonal business. Cows produced milk in the spring and summer and were dry for the rest of the year. As a result, prices for dairy products were always higher in the winter.

Some farmers practiced winter dairying, which meant keeping their cows in production throughout the winter. This allowed farmers to take advantage of the higher prices they could command in the cold weather months. But the main obstacle to winter dairying was finding sufficient succulent food to maintain cows' milk production through the winter.

## The answer to a dairyman's prayer

European ensilage reports must have seemed like the answer to a dairyman's prayers. Ensilage was the term used to describe the process of making and storing silage—green fodder used in the winter. Some Americans also used the term to refer to the final, processed product.

The silo served as the airtight receptacle for the ensilage, usually corn, that was chopped and placed inside. Air particles in the corn caused fermentation until all the air was expended. By storing the silage in an air-tight container, further fermentation was prevented, thereby preserving the silage until it was needed for feed.



**Silo with collapsed barn. Manitowoc County.**



**Silo and barn ruin. Manitowoc County.**



Silage and a workable silo opened the door to year-round dairying, making it a lucrative full-time occupation. At first there was some resistance to the idea of using silage, but the Wisconsin Agricultural Experiment Station, the Wisconsin Farmers' Institutes, and farm journals such as *Hoard's Dairyman* all promoted it. By the turn of the century, silos had become an accepted part of the farmstead.

## Early silos

As first introduced from Europe, silos were underground pits or long, shallow masonry buildings. Farmers in this country soon began "Americanizing" the silo—making it more efficient and affordable. Agricultural experiment station personnel and dairy farmers were involved in this effort, experimenting with different shapes, sizes and construction materials.

Early silos were rectangular or square, but gradually the advantages of the round form led to its domination. Wood, stone, brick, tile and poured concrete all served as construction materials. Silos that exemplify these changes in technology and materials can be seen throughout the state, often remaining when other farmstead buildings have disappeared.

The word silo comes from the Greek *siros*—an air-tight pit for storing grain. Greek and Roman farmers used silos to store mature grain. Besides this tradition, which was described by the Roman writers Marcus Varro, Columella and Pliny the Elder, the Germanic and Asiatic peoples traditionally stored green fodder and food in pits.<sup>1</sup> The 1800s brought a renewed interest in these storage methods and European farmers began to experiment with them. The *Report of the Commissioner of Agriculture for the Year 1875* contained the article "French Mode of Curing Forage" which described the

efforts of French and German farmers to store green fodder over winter. August Goffart, a French farmer who experimented with ensiling corn for many years, wrote *The Ensilage of Maize and Other Green Forage Crops*, an account of his elliptical masonry silo and ensiling methods. This was translated into English in 1879. Both of these publications made an immediate impact on American farmers.



**Square stone silo. Waukesha County.**



**Silos on a Fond du Lac County farm illustrate different forms and sizes.**

Levi P. Gilbert of Fort Atkinson built the first silo in Wisconsin in 1877<sup>2</sup> following the methods outlined in an 1875 United States Department of Agriculture (USDA) bulletin. His silo was an underground pit, 32 feet long, 12 feet wide and six feet deep, lined with straw. After using it for three years, Gilbert reported on its

effectiveness to a meeting of the Wisconsin Dairymen's Association. "The cows ate it [silage] with relish," he noted, "and it produced the same effects of green feed just from the field."<sup>3</sup>

The second Wisconsin farmer to build a silo, Dr. L. W. Weeks, followed the precepts of August Goffart after hearing about them in Europe.<sup>4</sup> Dr. Weeks' double silo, constructed in 1880, was built of masonry, with each side about 12 feet by 30 feet and 12 feet deep. William Henry, the dean of the University of Wisconsin College of Agriculture, came to visit Weeks and look at his silo. In 1881 Dean Henry received money from the legislature to build a silo on the experimental farm.<sup>5</sup> This silo was constructed of sandstone rubble and was 30 feet long, 15 feet wide and 15 feet deep, about halfway underground. The inside was coated with cement. In all of these early silos the silage was weighted down with earth or stone, about 100 pounds per foot, to keep air from entering and spoiling the silage.



**Goffart's triple masonry silos. From *The Ensilage of Maize, and other Green Fodder Crops*.**



**Silo built by John Hays in 1882 in Dodge County. Stone with wood jacket. College of Agriculture Archives.**



From these early endeavors, word of the silo spread throughout the state. Many farmers visited those who had built silos to see them firsthand. Articles in farm journals and newspapers also provided the impetus for some farmers to try the new invention. Most of the early silos in the state were built of stone, following Goffart's silo design.

Early silos were considered expensive to build; in addition, they required the services of a mason. Dean Henry and others were interested in making the silo affordable for all farmers. Henry wanted a silo that could be easily constructed of wood—the cheapest construction material of the time. Henry believed that silage did not cure as well in stone silos and that wood was superior because silage would not freeze when stored in it.<sup>6</sup>

Farm journals of the time used the word “Americanizing” to indicate the change from expensive to affordable for all. Although some farmers believed that underground silos were better, most built them above ground, which made them easier to unload. In 1881, Levi Gilbert built his second wooden silo, above ground. These silos looked like any other rectangular wood outbuilding with a stone foundation.

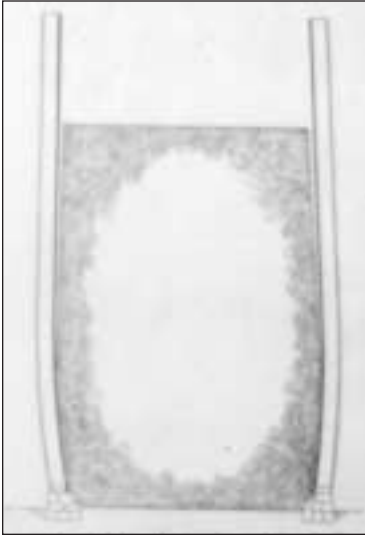
The drought of 1886 and 1887 proved to be a turning point in the acceptance of the silo in Wisconsin. Farmers attending the Wisconsin Farmers' Institutes meetings declared that having silos had kept them in business during the drought.<sup>7</sup>



**Barn of A. A. Arnold, Trempealeau County. Interior silo is filled through the dormer on the left.**



**Arnold's interior silo, constructed in 1887 of brick with a cement lining.**



**Bowed-out walls of a wood rectangular silo. Bulletin 59.**

## Working out problems

### F. H. King

Estimates around 1887 indicated that between 500 to 2,500 silos had been built. In 1889, the Wisconsin Agricultural Experiment Station Bulletin 29 estimated that there were about 2,000 silos in the state. Many of these were made of wood. But there were problems with rectangular wood silos. The walls bowed out, letting in air and the silage acids rotted the wood lining. Preventative measures, such as painting the lining with gas tar or linseed oil, were not effective.

This was the situation when F. H. King, a professor of agricultural physics at the University of Wisconsin, took an interest in silo building. He had designed a round barn with a round silo in the center for his brother, a dairy farmer in Walworth County.

In 1891, King undertook a silo survey in which he cataloged the construction problems of the silos he saw. King identified three basic flaws in wood construction:

1. The structures were not built strongly enough to withstand the lateral pressure of the silage.
2. Air pockets in the corners resulted in spoilage.
3. The inside lining rotted due to contact with silage acids.<sup>8</sup>

While King did not invent the round silo, he designed a round wooden structure that solved the construction problems. The walls of the round silo were strong enough to withstand pressure from the silage and the cylindrical form eliminated the problem of air pockets in the corners. The interior wall was separated from the outside by air spaces; King believed that adequate ventilation would reduce lining decay.

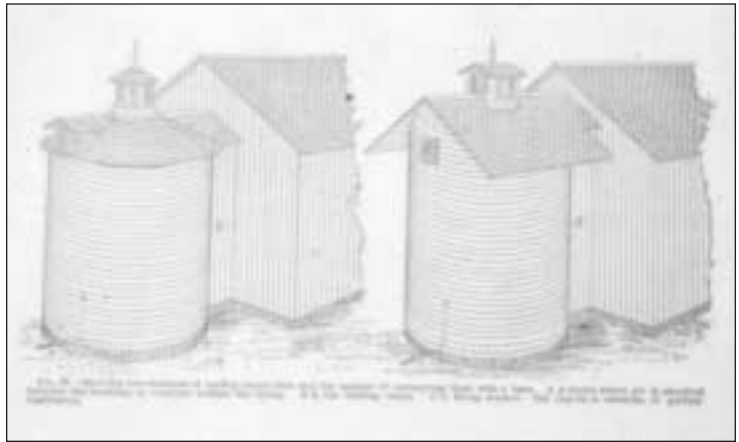


**King silo built in 1899 near Racine. The silo is 36 feet tall with a diameter of 24 feet.**

A related discovery about the nature of silage led to a change in the silo's form from horizontal to upright. This happened when it was discovered that the weight of the silage itself produced enough compression to exclude air—provided the silo was deep enough. King decreed that a minimum depth of 24 feet (later revised to 30) was necessary to avoid weighing down the silage. This round wood silo with horizontal siding became known as the King, or Wisconsin, silo. The USDA still recommended using a modified version of it up until the 1920s.

Another type of wooden silo, the vertical stave, was also introduced in the late 1890s. Stave silos utilized a single layer of wood, secured by circular iron bands, in a manner similar to water barrels. These silos worked well when full, but while empty in the summer, the dry staves shrank and the silos sometimes collapsed during rough weather.

King did not recommend the stave silo because it was associated with a high loss of silage,<sup>9</sup> but it was inexpensive and easier to construct than his own design; in fact, this vertical stave silo was the first commercial success. Many companies sold staves of different kinds of wood. The quality of the staves varied, but the best were beveled, tongued and grooved to fit together securely. Also built were double-walled wood stave silos that did not wrack and twist when empty.



**King silo with roof variations. 8th Annual Report.**



**Wood stave silo. La Crosse County.**

## Stone silos

Wisconsin farmers continued to build and use stone silos made of fieldstone or quarried rock. Early settlers found an abundance of fieldstone left by glaciation. Using this fieldstone for silos had the added benefit of helping to clear the fields for cultivation.

Richard Perrin, Wisconsin's eminent architectural historian, outlined three methods of building with fieldstone. The earliest probably involved using the stones as they were found, with plenty of mortar to hold them together. A later technique used by professional stonemasons was to split the fieldstones and place the faced sides out, using smaller stones for infill. The third method, originated in the 1870s, was to split all the fieldstone and lay it with a small amount of mortar. Building with

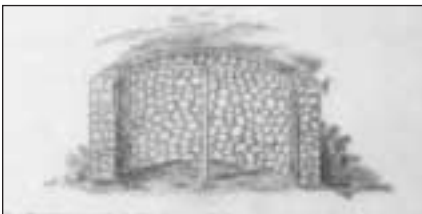
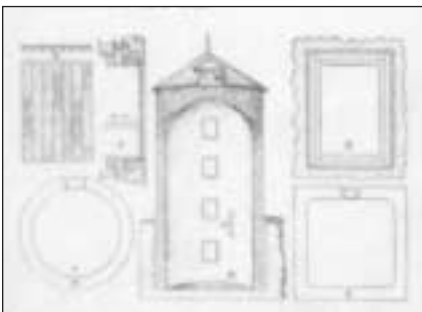
fieldstone had started with Wisconsin's early settlement and lasted until the turn of the century when it was mainly used for barn foundations and silos.<sup>10</sup> Stone silos were built in Wisconsin using all three building styles. Other stone silos were built of quarried rock, such as limestone.

Professor King's silo survey found that the owners of stone silos were generally satisfied with the structures' effectiveness. The principal problem with stone silos was that, over the years, the mortar inside became soft through contact with silage acids. King recommended lining the inside of stone silos with a mix containing a high proportion of cement to sand, and emphasized that the interior walls had to be perfectly smooth.

Wisconsin Agricultural Experiment Station bulletins published in 1897, 1900 and 1905 contained instructions for building both round and square stone silos. The 1905 bulletin stated, "There are a great many stone silos in Wisconsin. In general they are found to be very satisfactory."<sup>11</sup> Stone silos were built into the teens, gradually falling out of favor as poured concrete became the preferred construction material.



**Quarried limestone silo. La Crosse County.**



**Stone silo construction. Bulletin 83.**



**Stone silo built in 1912. Jefferson County.**





## New building materials

Around the turn of the century several strong, fireproof building materials were used to build silos, as well as barn foundations and other farm outbuildings. These materials included reinforced concrete, concrete block and tile. The durability of silos built with these materials contrasted sharply with the flimsiness of wood stave construction.

### Concrete

Concrete and cement were actually used as building materials going back to ancient times, but in the 19th century new technology increased their effectiveness. Portland cement was developed in the early 1800s. This cement was harder than natural lime mortar and was readily available by the turn of the century. Reinforced concrete, consisting of embedding metal rods in the concrete for increased strength, was invented in 1850.<sup>12</sup>

In 1911 the Wisconsin Agricultural Experiment Station published Bulletin 214, *Concrete Silo Construction*, which gave detailed instructions for building a silo of reinforced concrete. The first step was to construct the silo forms, or wood frames that held the wet concrete. When the concrete was set, the forms were removed and set up for the next level. Formulas for the correct concrete mixture were given in the bulletin.

For reinforcement, wire was preferred over steel rods. The reinforcement was placed about one inch from the outside of the forms. Charts provided the amount of horizontal and vertical reinforcement needed for silos of different diameters and heights. Instructions were also provided for building a conical concrete roof. This type of silo proved to be very popular in Wisconsin in the early part of the 20th century.

Concrete blocks were also used to build silos. The blocks could be purchased commercially or constructed from molds. Reinforcement was added between the block layers. The inside was coated with a cement wash to prevent silage acids from corroding the mortar. These silos were not considered as strong as the monolithic concrete construction because the blocks were made with sand, cement and fine gravel rather than the crushed rock used in the solid concrete wall.<sup>13</sup> Block silos were slightly more expensive to construct than poured concrete,<sup>14</sup> and they never achieved the widespread acceptance of the other concrete types.



**Homemade concrete block silo. Manitowoc County.**



**Rock face and plain concrete blocks in a Jefferson County silo.**

Concrete stave silos were the third type of concrete silo introduced at this time. The stave was designed with interlocking convex and concave sides, which eliminated the need for mortar. Concrete stave silos were encircled with iron rods in the same manner as wood stave silos. These silos proved to be very popular, and several companies developed different designs for them.

Concrete stave silos were always built by commercial companies. One of the early Wisconsin companies to construct them was the Madison Cement Stave Silo Company, which began in 1914.<sup>15</sup> This firm sold 15 silos in its first year of business; the number rose to 200 in 1918. These were mainly sold in southeastern Wisconsin but were also built as far north as Barron County.

### **Tile and brick**

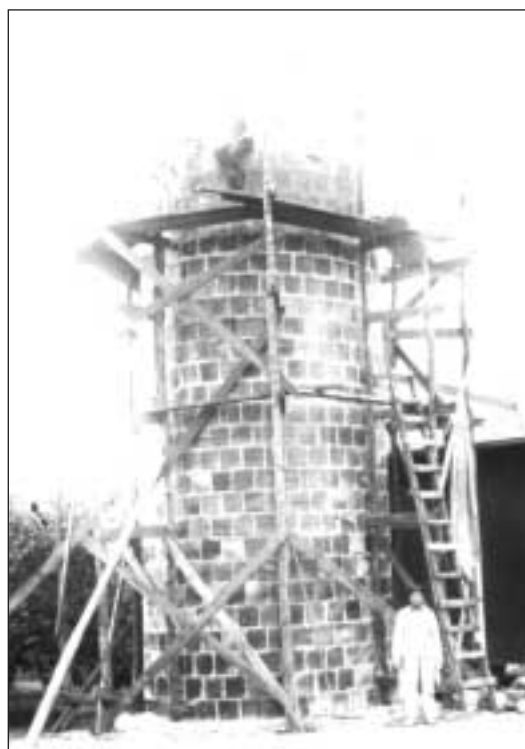
Tile silos were also developed at this time. At the turn of the century, tile, like reinforced concrete, underwent a period of experimentation as a construction material for farm buildings. Barn foundations, milk houses and even some houses were built of tile. It was extremely durable, with one drawback—although the tiles themselves were impervious to silage acids, the mortar used in joining the tiles was not, requiring an interior coating of cement. There are some silos built of tile staves, but they are very rare.



**Two monolithic concrete silos. Fond du Lac County.**



**Concrete stave silo, built before 1919 in Walworth County.**



**Tile silo construction. SHSW Whi (V2)906.**



**Natco “Imperishable” silos. Oconomowoc. College of Agriculture Archives.**

Some early silos were built of brick or had a brick lining. A double-walled brick silo was designed and patented by a Wisconsin farmer, James P. Christensen, who had learned brick masonry techniques in his native Denmark. The inner and outer brick walls of the Christensen silo were constructed with an “ingenious arrangement of openings in the header courses. These chambers are converted into flues, and used to conduct heat through the wall to prevent freezing.”<sup>16</sup> Fireplaces were built on both sides of the door. “Occasional” fires kept the silage from freezing throughout the winter. Steel rods were used in the outer layer of bricks for reinforcement. This design was illustrated in the 1905 Wisconsin Agricultural Experiment Station silo bulletin.



**Tile stave silo. Jefferson County.**



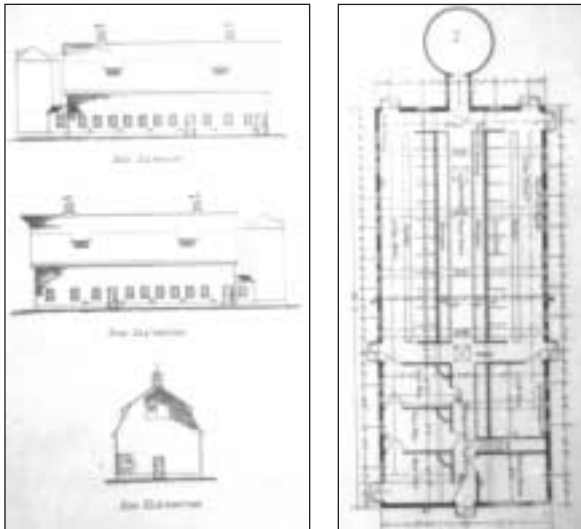
**Cream city brick silo in Manitowoc County.**

## Location of the silo

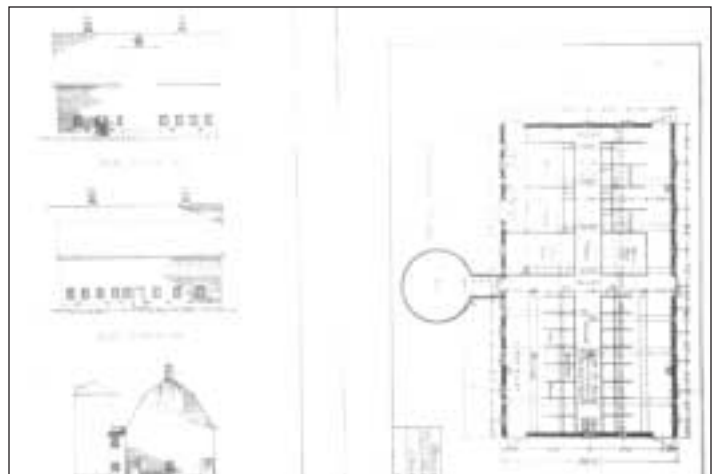
When silos first made their appearance, many thought they should be placed inside the barn to prevent silage from freezing. However, barn construction plans made no allowances for silos—a silo in a barn took up space designated for other purposes.

After silos became more common, barn plans were designed that included a silo located adjacent to the barn and connected to the feeding area. In University of Wisconsin Department of Agricultural Engineering barn plans, the silo was located either at the gable end or along the side of the barn. The side location allowed a driveway into the barn. It also allowed for barn expansion, which was usually accomplished by an extension on the gable end. Silos were located in the center of round barns, where they provided roof support. Although convenient for feeding out, the silo in a round barn was considered difficult to fill.<sup>17</sup>

By 1910, silo form and construction in Wisconsin had become fairly uniform. Round silos were the norm. These were built outside the barn with a connecting feeding room. Diameter and height were standardized: a silo should be about two and one-half to three times taller than its diameter. The average diameter was about twelve or fourteen feet. This was the optimum size for one man to efficiently fork down the amount of silage needed daily. The resultant height for this diameter was 35 to 40 feet—usually level with the barn roof. In the upper Midwest silo roofs were commonly used. Silo depth varied, but four to six feet below the feeding floor was preferred.<sup>18</sup>



**Wisconsin Agricultural Engineering Department barn plans illustrating silo location.**



**Wisconsin Agricultural Engineering Department barn plans illustrating silo location.**

## The patriotic silo

In 1916 the Wisconsin Department of Agriculture estimated the number of silos in the state at 60,000. Of these, more than half (33,000) were wood. The rest were concrete (18,000), tile (5,000), and brick (3,500). These were not distributed evenly across the state. Southeastern counties that had been involved in dairying for a long time had a greater concentration of wood silos. In areas where dairying was newer, concrete silos were more numerous.<sup>19</sup>

During World War I, the State Council of Defense, which was in charge of organizing community efforts to support the war, initiated a campaign to convince farmers to build silos as part of a larger food raising and conservation effort. Building a silo was equated with patriotism. This campaign was a success; in 1917 over 10,000 silos were built in Wisconsin—more than in any previous year.<sup>20</sup> In 1920 Wisconsin became the leader in the number of silos in the country. By 1924, Wisconsin boasted more than 100,000 silos.<sup>21</sup> For the next two decades silo form and construction materials remained consistent, with concrete and wood being the most popular.

Thirty years later, in 1946, 57 percent of Wisconsin's silos were concrete. Two thirds of these were monolithic concrete and one third concrete stave. Wood stave silos had declined proportionally, to only 27 percent of the total. Concrete block and tile silos accounted for six percent each.<sup>22</sup>

## Choosing the right silo

How did a farmer choose a silo? For some, price was the most important factor; others chose to build more costly silos that lasted longer. In 1908, a model barn was built at the Wisconsin State Fair. Two silos adjoined the barn, one of brick and one wood stave. Many farmers visited this exhibit. Later a tile and monolithic concrete silo were added. In addition to this, wood stave silo companies set up demonstration silos on the fairgrounds. Companies also advertised in newspapers and farm journals and sent agents to talk to farmers.

Wood stave silo companies promoted either the quality of their staves or some other unique feature, such as the “Self Adjusting, Automatic Take-up Hoop,” which never needed manual adjusting.<sup>23</sup> The Wood Tire Silo Company of Sheboygan, in business from 1914 to 1936, developed a double-walled wood stave silo. The “wood tire” was a four-inch ring to which inner and outer layers of staves were attached, forming an insulating air space and making the silo stronger. The double wall eliminated the need for metal hoops. The inner wall was made of redwood staves, which were not supposed to swell or shrink; the outer was constructed of pine or fir. There was a 20-year guarantee against decay and the company stated that the silo would not “rack, sag, twist or collapse.”<sup>24</sup>



World War I poster promoting silo construction. SHSW Lot 5-1183.

### “The Silo Beautiful”

Some companies promoted their silos’ attractiveness. The Christensen brick silos were advertised as “handsome” and “an ornament to any set of farm buildings.”<sup>25</sup> The Preston Lansing Company advertised its tile silo as “The Silo Beautiful.” Concrete silos of all kinds were advertised as durable and safe from frost, fire and vermin. Photographs of silos still standing after fire had destroyed the barn were used to promote their permanence, and insurance companies charged low rates for concrete silos because of their durability.<sup>26</sup>

Wisconsin Experiment Station personnel advocated the use of certain types of silos. In the 1890s, they fought a losing battle against the wood stave silo, wanting farmers to build a more permanent structure. In the early decades of the 20th century the monolithic concrete silo was extensively promoted by both the Station and Farmers’ Institutes. Silo forms could be rented from both groups. Miniature forms were available at the meetings to illustrate how they worked. Talks at the Institute meetings covered the advantages. Although concrete silos were originally meant to be built by farmers, around 1915 the Experiment Station declared that silos should be built by experts with farmers helping as needed. This development signaled the end of the homemade silo era.

## Innovations

### The Harvestore silo

Two major technological innovations occurred in the 1940s. The first of these began when the A. O. Smith Company of Milwaukee, an industrial equipment manufacturing firm, developed a process that fused glass to steel. Originally developed to build storage tanks for the brewing industry, the conversion of this technology to agricultural use began when a farmer commented to the president of the company, “If you were to set one of those glass-lined tanks up on end it would make a good silo.”<sup>27</sup>

After discussing conventional silo problems with officials at the University of Wisconsin College of Agriculture, a new type of silo, the Harvestore, was developed. It was displayed at the Wisconsin State Fair in 1948, just as silos of the early 20th century had been. The glass lining of the Harvestore successfully resisted silage acids. Silage did not freeze and there was less spoilage than with other types of silos. It could be filled at the top at the same time it was being unloaded at the bottom—an advantage over traditional silos. The cobalt blue color was also quite striking in the farm landscape. Since they were more expensive than concrete silos, Harvestore silos often indicated prosperous dairy areas.



Filling the silo in 1930. Manitowoc County Historical Society.



## Automatic silo unloader Silage bags

The second innovation, the automatic silo unloader, allowed farmers to unload silage without having to fork it down from the top of the silo, making the feeding process easier and more efficient. The automatic unloader also freed the silo from the size limitations imposed upon it by manual feeding out. The diameter and height of silos gradually increased to an average of 20' x 60' in the 1960s.

The most recent development in silo technology is the silage bag, made of heavy-duty plastic. These resemble long white garbage bags laid out on the ground. Silage is blown in and the bags are sealed by weighting down the ends with earth. These inexpensive silage bags work well unless they are damaged. They are often placed in the pasture for convenient feeding where they make a noticeable impact on the landscape.

## The legacy of silos

In the past 50 years the number of farms in Wisconsin has declined. Cities have encroached on farmland, and farmsteads once on the outskirts of town are now surrounded by housing developments. As farms grew larger, farmsteads in the country were abandoned. While many of the wooden buildings have been razed or have fallen down, many silos remain.

Stone silos are particularly characteristic of Wisconsin. Square and round, made of quarry stone and fieldstone, they were constructed using all the methods described by Richard Perrin. It is not known how many were built and how many still exist. Stone silos were never built in large numbers; they were not even counted as a distinctive type on the 1916 silo census. But in some areas of the state, clusters of stone silos survive. They are excellent examples of vernacular building techniques, rooted in the earth, and one of the last examples of the fieldstone building traditions of Wisconsin.



**Asbestos silo in Jefferson County. Asbestos was used as silo construction material during World War II.**



**Double tile silos with barn skeleton. La Crosse County.**

The monolithic concrete silo is also representative of Wisconsin. The use of this structure was promoted by the Wisconsin Agricultural Experiment Station and the Wisconsin Farmers' Institutes. Forms for its construction, made by Wisconsin companies and used by local builders, were rented, built or bought. Some of these concrete silos are fairly well-preserved, with their original roofs and chutes intact. They stand as sentinels of a former prosperity—and some are still in use. One farmer stated that his was difficult to fill but still made good silage.

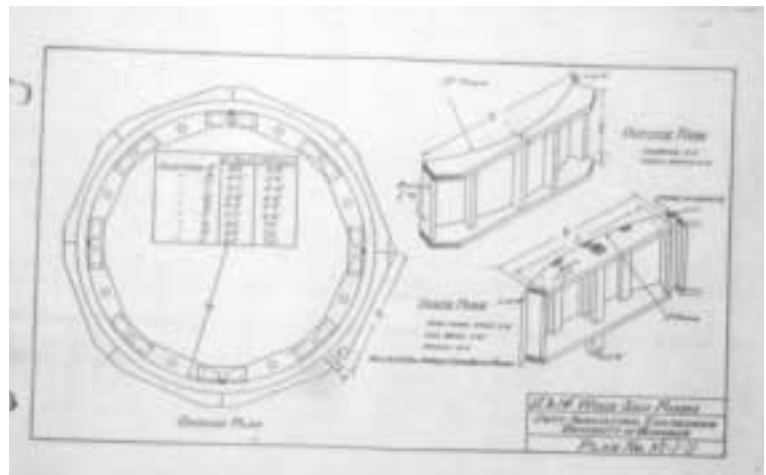
Before silos became standardized in the '40s and '50s, stone and concrete silos were hallmarks of the Wisconsin countryside. As such their importance should be recognized.

Silos, as much as any other farm building, have made a significant impact on the rural landscape of Wisconsin. They are a symbol of the state's prosperous dairy industry and the embodiment of the Wisconsin Idea—university people and farmers working together, applying new technology to a practical structure that all farmers could use.

Much of Wisconsin's early 20th century rural landscape is still visible today—its style and charm enhanced by the silo's distinctive silhouette. It is important to recognize silos as more than adjuncts to the barn. They should be studied for insight they reveal into American technological progress and preserved for their role in the history and development of the Wisconsin dairy industry.



**Stone silo. Racine County.**



**Monolithic concrete silo construction forms. Wisconsin Agricultural Engineering Department.**





## Notes

- <sup>1</sup> Tacitus *Germania*, p. 99; Quintus Curtius *Historiarum Alexandri Magni Macedonis*, p. 157.
- <sup>2</sup> Fish, Norman, “The History of the Silo in Wisconsin,” *Wisconsin Magazine of History*, December 1924, pp. 161–162.
- <sup>3</sup> Gilbert, L. P., “Ensilage,” *Eighth Annual Report of the Wisconsin Dairymen’s Association*, p. 117.
- <sup>4</sup> “Silo,” *Wisconsin Free Press*, n.p.
- <sup>5</sup> Henry, W., “The Ensilage of Fodders,” *Experiments in Amber Cane and the Ensilage of Fodders at the Experimental Farm*, p. 60.
- <sup>6</sup> Henry, W., “Silos and Silage I,” *Breeders’ Gazette* 13, p. 515.
- <sup>7</sup> Gould, John, “Has the Silo Proved Its Claims?” *Wisconsin Farmers’ Institutes Sessions of 1886–7*, p. 181; Lampard, Eric, *The Rise of the Dairy Industry in Wisconsin: A Study in Agricultural Change 1820–1920*, p. 159.
- <sup>8</sup> King, F. H., *The Construction of Silos*, Bulletin 28.
- <sup>9</sup> King, F. H., “The Round Silo Built With Hoops and Staves,” *Hoard’s Dairyman* 25, p. 221.
- <sup>10</sup> Perrin, Richard W. E., *Historic Wisconsin Buildings*, p. 69.
- <sup>11</sup> Knapp, G. N., *Silo Construction*, Bulletin 125, p. 59.
- <sup>12</sup> Nashert, *America’s Builders*, p. 116.
- <sup>13</sup> Knapp, G. N., *Silo Construction*, Bulletin 125, p. 77.
- <sup>14</sup> Universal Portland, *Concrete Silos*, p. 30.
- <sup>15</sup> “Madison Silo Concern Growing Enterprise,” *Community Business* 3, pp. 1–2.
- <sup>16</sup> Knapp, G. N., Bulletin 125, p. 56.
- <sup>17</sup> Zeasman, Humphrey and Schindler, *Dairy Barns*, p. 16.
- <sup>18</sup> White, Frank M., *Silos: Questions and Answers*, Wisconsin Agricultural Extension Service, Circular 87, p. 3.
- <sup>19</sup> *Biennial Report of the Wisconsin Department of Agriculture for 1915, 1916*.
- <sup>20</sup> Russell and Hatch, *Serving Wisconsin Farmers in Wartime*, p. 6.
- <sup>21</sup> Packard, et al., *Silos and Silage*, p. 43.
- <sup>22</sup> Packard, pp. 22–23.
- <sup>23</sup> International Silo Company, *The Story of the Silo*, p. 16.
- <sup>24</sup> *Sheboygan County Atlas*, n.p.
- <sup>25</sup> *Wisconsin Country Magazine*, n.p.
- <sup>26</sup> Gaylord and Wilson, “Concrete Silos,” p. 7.
- <sup>27</sup> Suter, *The Courage to Change*, p. 46.

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**Stone silo built circa 1900. Manitowac County.**

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