

THIS OLD SILO: When Concrete Tower Silos Fail

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Last fall I wrote briefly about a concrete stave silo in Cayuga County that started to lean while it was being filled. Over the course of a week it moved a foot away from an adjacent attached barn. If it had fallen over, there would not have been enough feed to get the animals through the winter. Here is the rest of the story about how the silo was stabilized, as well as some maintenance tips for those of you who still use concrete tower silos on your farm.

The photos below show how the silo looked last fall when it started to lean. The cause of the problem was that



Silo (left) pulling away from the barn. The board in the center was used to monitor the rate of shifting. Photo used with permission of owner.



Photo taken October 2007, used with permission of owner.

the silo's foundation was below grade (below the surface), and the drains surrounding the foundation had become plugged, allowing moisture to penetrate the bottom course of staves. Freeze-thaw cycles slowly degraded the staves over the decades. (This silo was built prior to 1971.) The staves at the base gradually weakened until they were finally crushed by the weight of the staves above.



Base of silo showing deterioration of bottom row of staves. Photo used with permission of owner.



Base of silo temporarily reinforced with "shotcrete" concrete. Photo taken July 2008, used with permission of owner. The silo will be taken down this fall.

Fortunately, the farm had an established working relationship with a silo company that has many years of experience with old silos. The company was able to

stabilize it by reinforcing the bottom with “shotcrete” concrete that was sprayed on (see photo).

Maintain Silo Liners

Silage juices are extremely corrosive and can also contribute to deterioration of staves or blocks, especially when the interior cement liner is not maintained. If the staves are the hollow core type, as was the case here, the silage juices can also eat away at the staves from inside the core. The acidic juices will react with the cement and literally dissolve it over time. For this reason, concrete silos are constructed with an interior liner or coating to protect the walls. There are many kinds of cement coatings, not all of which are suitable for forage silos. The two basic kinds of coatings for agricultural use are cementitious coatings and liquid coatings. Cementitious coatings are a mixture of sand and a binding agent. If Portland cement is used for the binder, it is itself subject to attack from the silage acid, and the coating is considered a sacrificial coating that must be replaced more frequently, unless it is in turn protected by an acid-resistant coating. Liquid coatings penetrate the surface of the concrete or react with the free lime in the Portland cement to create an acid-resistant layer.

Given the critical nature of correctly selecting and applying the liner material, work of this kind should only be done by a skilled and knowledgeable contractor, who will have the necessary protective equipment as well. Curt Gooch, our PRO-DAIRY Facilities and Waste Management Engineer, offers the following guidance:

“I think the biggest item that farms with tower silos need to do is to maintain the interior side. The silage acid eats concrete quickly and, if left, can result in silo failure. For the liners, I suggest a concrete specialty company be contacted to see what products they have that would meet the requirements. I usually talk with the technical assistance folks and tell them what the need is and ask which product that they handle will work, and get the specifications on surface preparation.”

Ways to Minimize Corrosion

Harvesting and ensiling forage at the correct moisture content will help minimize seepage of excess silage juices at the base of the silo. If the base of the silo is below-grade, a tile drain can also help prevent the lower staves from being continuously immersed in seepage. Allowing the inner wall to dry out in between fillings may also offer some structural benefit.

Inspect Regularly

The bottom 10–15 feet of the silo wall should be inspected at least annually, both inside and out. Use a screwdriver or a hammer and chisel to test the wall for softness. The National Ag Safety Database advises inspecting the following as well:

- “1. Wooden doors should be checked for rot and physical damage.
2. Check bolts and bolt heads for tightness and degree of corrosion.
3. Evaluate corrosion and physical damage to door steps and latches.
4. Cast iron hinge eyes should be tightened and assessed for corrosion.
5. Concrete door frames should be checked for deterioration and physical damage. Doors must seat properly in their frames for latch systems to work effectively.
6. Replace wire cable on the unloader if signs of wear are evident. Outside ladders should be fitted with structurally sound safety cages to prevent falls.”

(see <http://www.cdc.gov/nasd/>)

The database also advises to “Seek professional advice concerning silo repairs if you suspect that concrete deterioration has occurred.”

Conclusion

While it’s true that concrete tower silos are gradually being replaced by bunker silos and “Big Blues”, I still see quite a few of the older tower silos as I drive around the county, quietly doing their job as they have for years. Most of them have foundations that are below-grade, which could be accidents waiting to happen. A regular schedule of inspection and maintenance will help you to get more years of safe operation out of your system, as well as warn you of when it may be time for “this old silo” to come down.

Further Information

The Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) have two excellent fact sheets on concrete silos on their website, both written by H.E. Bellman, Argue and Associates, Guelph (1990):

1. Deterioration of Concrete Tower Silos
<http://www.omafra.gov.on.ca/english/engineer/facts/90-235.htm>
2. Concrete Tower Silo Maintenance and Repair
<http://www.omafra.gov.on.ca/english/engineer/facts/90-236.htm>

To contact OMAFRA, call 1-877-424-1300 (Local 519-826-4047), e-mail ag.info.omafra@ontarion.ca

If you do not have Internet access and would like copies of either of these fact sheets, call Brian Aldrich at 315-255-1183.

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The author wishes to thank the owner of the silo for granting permission to tell this story, so that others may benefit from what we learned, and be safe.