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Grian Bin Damage: Claimed to be the result of high wind pressure.

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Grain Bin Collapse – Wind or Other Phenomena ??

As one travels through rural farmland in the midsection of our country and Canada during late summer and fall, grain bins and silos on farms and at grain terminals are loaded and unloaded repeatedly as grain products are harvested, moved to storage, and then transferred from storage to processing facilities. Most of this activity coincides with a period of time when the tall majestic "structures on the plain" are most vulnerable to severe storm events containing high wind.

Every year windstorms take their toll on all types of high profile grain bin and silo structures. However, what may appear to be wind damage often can be attributed to other phenomena that are not related to high wind pressure. This article deals with steel grain bin structures. However, many of the characteristics described also relate to other types of grain storage structures.

Most cylindrical steel grain bins are loaded through the top in a manner that assures an even distribution of grain within the bin. As the air space within the bin is displaced by grain product, air is evacuated through vents or breather valves in the roof of the bin. Walls are normally a corrugated, bolted steel plate design. However, many bins and silos are welded steel plate structures. Each layer of steel forms a ring. Steel plates are designed to withstand internal loading with a wall thickness that is greatest in the bottom rings and gradually reduced in rings toward the top of the bin. Larger bins are constructed with stiffeners that reinforce the walls and increase lateral stability.

When investigating a grain bin collapse, it is important to check material thickness of the steel plates within the area of structural failure and compare measured thickness with the manufacturer's specifications.

An external overpressure can occur that results in wall damage resembling wind damage while a bin is being unloaded if there is failure of a breather valve or roof vent. When air cannot enter the bin to fill the air space that had been occupied by grain, an external overpressure is created that can resemble wind damage. Noise associated with structural distress cannot be heard by operators due to auger motors, blowers and other operational noises. Therefore, minor damage can go undetected for a period of time.

When investigating claims, it is important to check vents and/or breather valves to determine if they may have been plugged or inoperable. An external overpressure caused by venting problems may also cause the top of the bin to collapse or deflect inward.

Most grain bins have a mechanical blower that forces air upward through vented floor panels and void spaces in the grain. Upward air movement through a wet grain produces an upward migration of moisture. Moisture laden air is vented through roof vents or breather valves. However, in cold climates, moisture in the grain in the upper portion of the bin and along the

walls may eventually freeze and adhere to the wall surface. When grain is unloaded, frozen grain can "bridge" and as grain is withdrawn through a hopper in the center of the floor, a cavity develops beneath the bridged grain. Eventually, the "bridged" grain will collapse into the cavity. The sudden displacement of the "bridged" grain creates a momentary vacuum in the space vacated by the fallen grain as vents or breather valves may not have the intake capacity to admit air at a rate equal to the rate of sudden displacement of the bridged grain. **Thus an external overpressure is created that can damage walls of the bin.**

Vents and valves may also have become restricted due to ice formations created as moisture in the exhausted air became frozen when making contact with the cold steel around the vent. If a blower is operational when vents and breather valves are frozen, an internal overpressure will occur that results in a phenomena known as "puff up" as the conical shaped roof takes on the shape of a dome. In extreme cases the roof can tear or appear to have been lifted off by wind pressure or flattened by snow loading.

Another factor in grain bin operations that can cause structural damage to walls that may appear to be wind damage is the deformity or flattening of corrugations in the lower half of the wall. When this type of structural damage occurs along the axis of the auger, it is often an indication of uneven distribution of the grain within the bin. If grain is withdrawn through a side hopper before the level of grain has been lowered to where the center hopper can no longer function, an unbalanced load on the walls is created that can flatten or collapse corrugations.

Bin manufacturers caution against withdrawal from side hoppers until all grain that can be unloaded through the center hopper has been withdrawn. Some inexperienced operators ignore this warning when they are in a hurry to unload the bin.

We have also seen grain structure damage resulting from negative pressure that develops on the sheltered side during a high wind event. An open manway on the sheltered side of an empty structure creates a path for air to move from the interior to the negative pressure zone on the exterior of the bin. This creates an external overpressure on the side exposed to the wind pressure that can damage the wall or collapse the structure.

Grain bins and other vertical structures are normally designed to withstand positive and negative wind pressure as set forth in building codes. **It is our experience that most wind damage claims on steel grain bins that do not display the obvious characteristics of wind damage are claims for structural damage that can be attributed to one of the above described phenomena , and are not the direct result of a high wind event.**

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