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## Ventilation Systems — Redundancy is Essential

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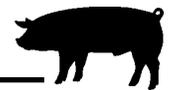


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designing sidewalls, end walls, doors and such. Upward forces imposed by wind loads determine the need for bracing of truss members, lateral/longitudinal bracing of the overall structure, pole or post embedment and uplift forces at truss-to-post joints. The minimum recommended wind design load is 15 psf. Higher loads are needed for buildings with eave heights greater than 16 feet. A load of 20 psf, roughly the equivalent to an 88 mph wind, is recommended for tall buildings, buildings important to a farming operation and for lower-profile buildings in exposed locations. Loads other than wind, snow and weight of a structure, (i.e., the weight of stored products, suspended feeders, poultry cages, cranes, etc.) should be added to the loads in Table 1 to determine the total roof design loads.

Many designers believe “zero” failure designs are impractical and non-economical. That philosophy is not appropriate for the designer, builder or producer building the structure. The loss of a livestock building during win-

ter conditions can be devastating. In addition to the direct loss of livestock, productivity is adversely affected — often for many months. Buildings are commonly insured for the direct cost of the structure, but there is no practical way to insure against the loss of production. For example, a purebred pork producer with many valuable animals may never be able to re-establish the genetic base. Such losses are generally not insurable.

Causes of structure failures investigated during the past five years include:

1. Lack of longitudinal bracing of truss members loaded in compression. Members buckled and failed. (three buildings)
2. Corrosion of truss plates. Truss failed at mid-span joint.
3. Non-preserved-treated post rotted. Wall pushed out.
4. Inadequate embedment and/or anchorage. Building posts

pulled from ground during moderate wind storm.

5. Inadequate fastening at truss-to-post joint (eave of building). Joint pulled apart during moderate wind storm.
6. Inadequate anchorage of grain bins. Bins pulled loose from footing and were destroyed during moderate winds.

Designing for excessively heavy loads can make buildings uneconomical or unaffordable. At the same time, producers should assure the building they purchase will meet their needs with minimum risk of adverse influence on their income-producing ability. Avoid constructing both buildings with an expected life of hundreds of years and those which will fail with the first gust of wind or first few flakes of snow are both unwise.

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## Ventilation Systems — Redundancy is Essential

Gerald R. Bodman<sup>1</sup>

### Summary and Implications

*Ventilation system failure can kill many animals in a few minutes. This kind of loss is often non-insurable. Adequate backup systems can reduce the risk of loss. Producers should install backups, or system redundancy, consistent with the level of risk they consider acceptable.*

### Introduction

“Fans Quit — Pigs Suffocate.” “Ventilation System Failure Kills Pigs.” Most producers have seen headlines like these. Similarly, salespeople for various products have used these headlines as opportunities to merchandise

their version of safety equipment or a “safer” system.

Mechanically ventilated buildings have long been recognized as a safety risk during an electrical system failure. Non-mechanically ventilated, modified-open-front (MOF) buildings are generally viewed as less risky, since they are not dependent upon fans for air movement. However, others have argued that MOFs are risky due to possible cable or rope breakage.

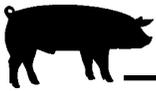
Currently, construction of buildings for growing-finishing pigs includes flat ceilings, curtain sidewalls, totally slatted floors and a hybrid ventilation system. Most of these buildings use fans for cold and hot weather ventilation (tunnel system) and non-mechanical ventilation during mild and warm weather. These buildings also pose safety risks during an electrical

system failure.

When dealing with a piece of electrical or mechanical equipment, the question is not “*if*” failure will occur, but “*when*”. Therefore, the goal should be to ensure — to the best of our ability — that the system will fail-safe, i.e., with minimum risk of loss or injury to people and animals. A major challenge in designing livestock production facilities is in developing a system with an acceptable risk-loss level.

Redundancy implies excess. Alternatively, redundancy means having a backup. For example, spare tires are redundant to the four tires on a car. The extra tire costs money. Nonetheless, most people carry a spare tire in their car or truck to minimize a flat tire’s inconvenience. Redundancy is

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needed in ventilation systems to minimize the risk or magnitude of loss.

### **Examples of Ventilation System Failures**

The following examples help to illustrate why a redundant ventilation system is needed.

Example one, a swine nursery was constructed with raised decks. Minimum ventilation was provided with a fan ducted to exhaust air from beneath the decks. During cold weather one night, a water line broke and filled the pit, closing off the fan duct. Result: Non-insured loss of 242 pigs.

Example two, a multi-room, mechanically ventilated nursery had several rooms equipped with gravity/static pressure-controlled box inlets. An electrical system failure during mild weather resulted in no fans operating and all inlets closing in three rooms. Result: Non-insured loss of over 300 pigs. No losses occurred in five other rooms with positive controlled inlets which remained open.

Example three, a two-room nursery facility used a single, centralized, computerized controller to operate ventilation equipment and monitor conditions in both rooms. A resistor (\$2 item) failed in the master control board. Result: Non-insured loss of over 250 pigs.

Example four, a 500-head growing-finishing building (one of six on the site) was equipped with total slats, two-stage air-inflated curtain sidewalls, four pit fans and a sidewall fan. A centralized control system with multiple sensors and relays was used to operate and interconnect various ventilation system components. The air-inflated curtains were sold as a “hedge” against electrical system failure—if the power goes off, the inflating fan stops and the curtain opens. As designed, if both stages of both curtains close, the pit fans should turn on. The contact points in the pit fan control relay (a \$10-\$15 item) arced and became pitted, causing intermittent operation. During a cool July, the curtains closed, but the pit fans did not

turn on. Result: Non-insurable loss of 257 market-weight pigs.

Example five, a mechanically ventilated growing-finishing building was equipped with 230-volt fans. Electrical service to the building was lost when one phase conductor of the underground electrical service burned off. (The aluminum conductor was less than four years old.) Evidence indicated significant pre-failure corrosion. Result: Non-insured loss in excess of \$40,000.

### **Options for Redundancy**

Options for redundancy to reduce loss risk when the ventilation system fails include:

1. Standby power source—automatic or manual start
2. Alarm system
3. Combination of 115/230-volt fans
4. Multiple circuits to fans, curtain controllers, heater, etc.
5. Multiple curtain controllers per room
6. Thermostatically controlled fan independent of centralized master controller
7. Smoke alarms
8. Carbon monoxide alarms.

In two of the five examples above (no. 1 and 4), most alarm systems would have been ineffective. The most cost-effective backup system, i.e., redundancy, depends upon the system being protected and failure against which protection is desired. No backup system is 100 percent reliable.

Regardless what system is installed, routine maintenance and inspection are required to help ensure the system will perform as expected when it is needed. Complacency makes a non-functional backup system worse than none at all.

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