# Energy-efficient poultry shed ventilation

*Mechanical ventilation can optimise the transfer of temperature and the removal of harmful gasses from poultry production facilities. Setting controls to regulate air exchange automatically will allow sheds to maintain desired temperatures with minimal loss of conditioned air. Reducing the loss of conditioned air within facilities enables the maintenance of optimal temperature without requiring as much energy for heating and cooling.*

## Introduction

Ventilation is a critical process within many intensive agricultural facilities, enabling adequate transport (addition or removal) of heat, cooling moisture, harmful gases such as carbon dioxide and harmless gases such as oxygen.

Traditionally, open and closed poultry sheds in Australia have been passively ventilated (also referred to as 'natural ventilation'). The prevalence of mechanically ventilated, closed sheds continues to grow, however, thanks to their ability to control growing conditions more precisely and ensure bird health.

## Ventilation needs

Typically, open poultry sheds are constrained to warm climates that match a chicken's comfort conditions. These types of shed are often characterised by a roof covering and low level walls and / or mesh, providing little to no form of climate control for the chickens. In these cases, no ventilation systems are applied, with some local heaters used as required.

Closed poultry sheds typically incorporate some level of ventilation via either passive or mechanical means in the attempt to control internal conditions. Bird growth, health and quality are largely dependent on internal conditions, which in turn, are largely a function of ventilation. Ventilation requirements change with ambient conditions (temperature, humidity, wind), a chicken's stage of development and bird density, shed size and air tightness, and as such, require careful consideration.

### Passive ventilation

Poultry sheds employing passive ventilation typically utilise side-wall curtains or louvres as well as ridge, roof or high wall openings to provide fresh air. This type of ventilation eliminates fan energy and maintenance costs. The flow of air in passively ventilated systems is dependent on pressure or temperature differences (wind and buoyancy), usually resulting in an inability to provide close control of internal conditions.

Aim to maximise the space between and around sheds to improve contributions from wind-driven ventilation.

In modern passively ventilated sheds, control over conditions is improved through incorporating automated control of curtains, panels, louvres and openings.

## Quick tips

- **Seal gaps and control doors and windows.** The efficiency of insulation and of your general heating, ventilation and cooling (HVAC) solution depends on the integrity of your building envelope.
- **Make a quick insulation audit.** Review the existing insulation in your sheds. There may be some obvious omissions and opportunities.
- **Automate your system.** Consider installing digital control systems and sensor technology to reduce labour costs and potential for human error.
- **Consider the entire HVAC solution.** The suppliers of elements of your ventilation system won't necessarily look at the full heating, cooling and ventilation picture or understand the specific needs for your industry. If significant investment is involved, consider obtaining expert advice from a party who's not a vendor.

### Mechanical ventilation

Mechanically ventilated systems employ a combination of fans, inlets/louvres, sensors and automated controllers for climate control and the introduction of fresh air. This type of ventilation typically provides farmers with the ability to more closely control internal conditions, air velocity and mixing, and air change rates. The drawbacks of this ventilation strategy are additional capital cost, maintenance requirements and associated energy costs. Reliability of energy supply also becomes a factor for mechanically ventilated systems, with back-up generators adding additional cost to the system.

Poultry farmers looking to convert passively ventilated sheds to mechanically ventilated sheds may wish to consider the following factors.

## Air tightness

Where a lack of resistance to air flow can be beneficial in some naturally ventilated buildings, mechanically ventilated systems need to ensure that air flow patterns produce the required mixing and that air being pushed through ventilation fans is being sourced appropriately. Usually, the amount of air being pushed through a fan can be regulated, whereas adequate air movement through a poultry shed may be less easy to achieve. Excessive air leaks can result in low velocity at the designated air inlets, creating areas of low or no air movement and uneven air distribution (Anon., n.d.). Further, air leaks that

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bypass supplementary heating and cooling (e.g. evaporative cooling pads) can cause unwanted temperature gradients, drafts, cold spots or hot spots, and can result in additional energy consumption. One means by which to review shed air tightness is by conducting a static pressure test (Czarick, 2010).

*Figure 1: These ventilation fans have shutters to block air flow when they aren't running. You can see light (and air) streaming through the shutter on the left, while the shutter on the right has been sealed to control air flow. Shed doors and other passive ventilation points also allow unregulated air into a building and can result in significant avoidable energy usage (Source: NSW Farmers).*

## Insulation

The role of insulation in poultry sheds is to reduce the rate of heat transfer to or from the shed from both radiant and conductive modes of heat transfer. This will reduce the shed's heating requirement in winter as well as its cooling requirement in summer.

Insulation should be a key consideration in the development of closed, naturally ventilated poultry sheds in order to improve control over conditions, as it is a relatively low-cost solution to the problem of providing protection from heat gain and loss. There are many types of insulation available, including glass or mineral wool batts or blankets, and expanded or extruded polystyrene.

Typically, the performance of insulation is measured by its thermal resistance or R-value (measured in units of $m^2K/W$), which is the inverse of the overall heat transfer coefficient (U-value, expressed in units of $W/m^2K$). A larger R-value is desirable as this equates to a smaller U-value, meaning that the rates at which heat is transferred per unit area, per degree of temperature difference between inside and outside is lower (Donald, 1999). The ease with which your shed insulation can be augmented will depend on what you currently have in place, and what type of insulation you select.

## Automation

A key benefit of mechanical ventilation is that it allows for automation of the system. Modern sensor technology coupled with smart digital control systems reduces labour costs and the potential for human error.


*Figure 2: Controls for ventilation fans in a poultry shed.*

## Energy costs

Your energy costs will be proportional to the required rate of ventilation. The ventilation rate, fan selection and ambient conditions will dictate the number of fans required, fan speed and the duration of operation. Run time, fan speed and condition (load), and the relationship between fan and system responses to changes in conditions (static pressure) will all inform energy consumption.

As a rough guide, the three items mentioned above should be considered in order. Note that it is generally cost-effective to spend additional money ensuring air tightness and insulation, as these improvements will result in reduced capital expenditure requirements and lower ongoing operating costs.

## Key parameters in evaluating quotes

In assessing the potential for converting passively ventilated poultry sheds into mechanically ventilated ones prior to investment, you'll need to consider many factors, including:

- potential impacts on marketing their product,
- resulting increases in energy consumption and cost, and
- the capital cost of installation, including the cost of additional insulation, fans, improving air tightness, actuation of openings, controllers and sensors.

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## Further information

***World Poultry: 'Ventilation systems vital to poultry houses'.***
The types of ventilation systems available for use in poultry houses.
*www.worldpoultry.net/PageFiles/24659/001_boerderij-download-WP5976D01.pdf*

***Engormix: 'The 8 most often asked Questions on Ventilation in the Field'.***
*en.engormix.com/MA-poultry-industry/genetic/articles/poultry-ventilation-t1619/103-p0.htm*

***Hydor: Poultry Ventilation – Best Practice Management for Meat Chicken Production in NSW*.**
This DPI publication instances various guidelines related to poultry production, including ventilation systems.
*www.dpi.nsw.gov.au/agriculture/livestock/poultry/development/bpm*

## References

Anon., n.d. [Online]
Available at:
*en.engormix.com/MA-poultry-industry/genetic/articles/poultry-ventilation-t1619/103-p0.htm*
[Accessed November 2013].

Czarick, M. &. F. B., 2010. House tightness charts. *Poultry environment & energy conservation poultry housing tips, Vol. 22(10)*.

Donald, J., 1999. Need for insulation in warm climate poultry houses. *Auburn University poultry ventilation and housing, PVP #9*.



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