Air inlet design and control

The importance of air inlets is often underestimated. There are many ideas about positioning, design and material of which the baffles should be made of, but most crucial remains how to manage them properly.

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The air inlet is the most important part of every ventilation system. Without proper air inlets no ventilation system can function satisfactorily. Inlets are responsible for providing good air movement throughout the poultry house - not the fan. The fan is only the air pump.
The functions of an air inlet are:

- to provide fresh air throughout the barn,
- to maintain a fast inlet air velocity so that good air mixing occurs and adequate air circulation within the barn is provided.

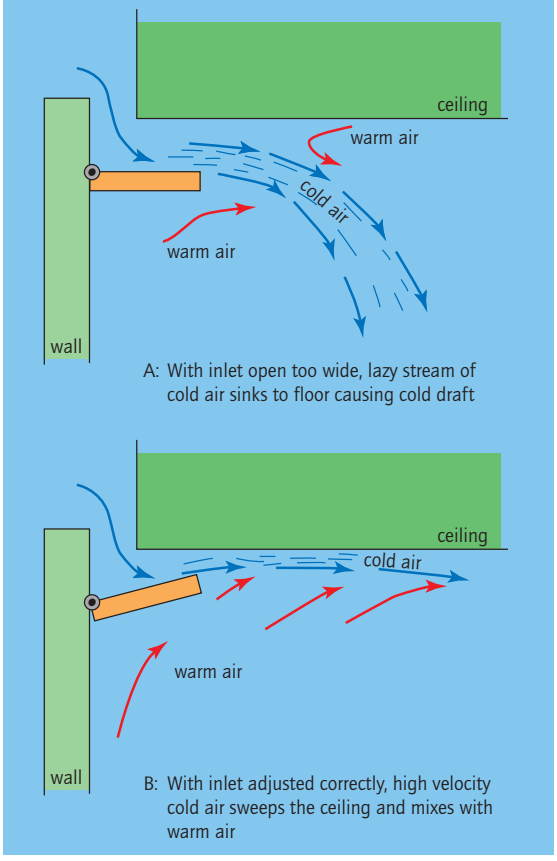
If these functions are not achieved, then poor air distribution, uneven temperatures and drafts are the result.

Inlet sizing

When air flows through any opening, the cross-sectional area of the issuing jet is reduced to 60%-80% of the total free area of the opening. This phenomenon, known as the vena-contracta effect, increases the velocity of the air emerging from the opening and should be taken into account when sizing the air inlets. A common rule of thumb sizes air inlets at 0.2 m^2 of inlet opening per 1000 L/s of air exhausted (1 ft^2/1000 CFM). However, when the vena-contracta effect is considered these inlets should be sized on the basis of 0.33 m^2 per 1,000 L/s (1.67 ft^2/1,000 CFM). Expressed another way one can calculate the size of the air inlet opening by substituting a velocity of 3 m/s (600 ft/min) in the formula presented in the box.

This design prevents the air intake opening to the outside of the poultry house from developing much static pressure ahead of the inlet control baffle. Too little air intake opening can destroy all attempts to control the air flow within the house space and of course can overload the fans due to the restriction (*Figure 1*).

Figure 1. Effect of inlet slot size



A: With inlet open too wide, lazy stream of cold air sinks to floor causing cold draft

B: With inlet adjusted correctly, high velocity cold air sweeps the ceiling and mixes with warm air

Location

Since this fresh air must be distributed throughout the building it is necessary to have either a continuous slot-type inlet or point source inlets with an effective distribution mechanism such as a nozzle assembly on an intake fan or an air tube distribution system. Introducing air in blocks (such as windows) tends to cause drafts at that location and dead spots where there is no inlet.

Regardless of the type of inlet, location is critical and obstructions or restrictions to the air flow before and after it enters the intake must be avoided. Restrictions before can cause a pressure drop on the intake air even before it reaches the inlet baffle. Obstructions after the inlet, such as electrical conducts, a corrugated steel ceiling, beams and joists will deflect air down into the pen area and possibly cause drafts as well as destroy good air circulation within the house.

Positioning the air inlet baffles requires continuous attention.

The size of the air inlet opening
A=Q/1,000 V
A = cross-sectional area of inlet in square meters (ft^2)
Q = fan exhaust capacity in L/s (CFM)
V = inlet velocity in meters per second (ft/min)
(Note: value 1,000 does not occur in the formula with imperial units).

Direction of airflow

It is desirable to inlet air across the ceiling to avoid cold drafts on the birds. In any barn containing sensitive livestock, this incoming air should be warmed up by the warm room air before it reaches the area where the birds are located. Also, the air velocity at bird level should be within acceptable limits to avoid drafty conditions.

The air inlet must be adjustable in order that a fast inlet air velocity is maintained. When cold air enters a warm barn, it is heavier than surrounding warm air and sinks rapidly to the floor causing cold drafts. To solve this problem, the cold air must be directed along the ceiling and jetted forcefully (4-5 m/s or 800-1,000 ft/min) into the room to promote rapid air mixing and prevent sinking. Adjustment is also

Figure 2. Measuring Static Pressure

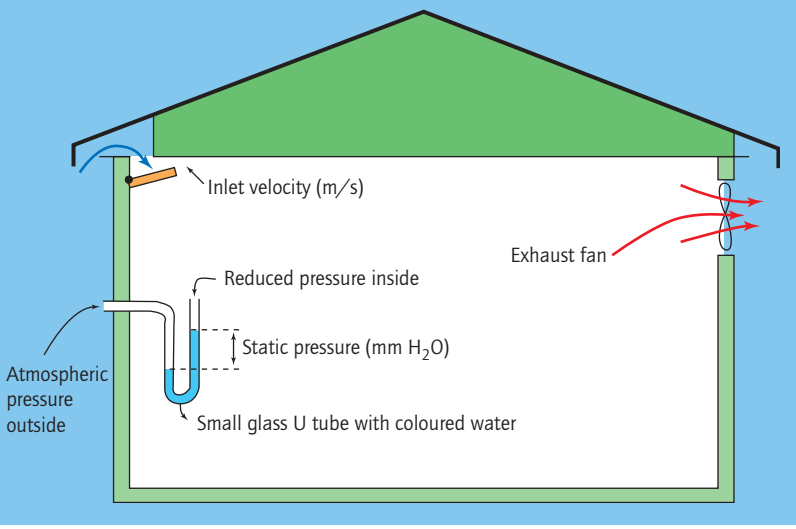
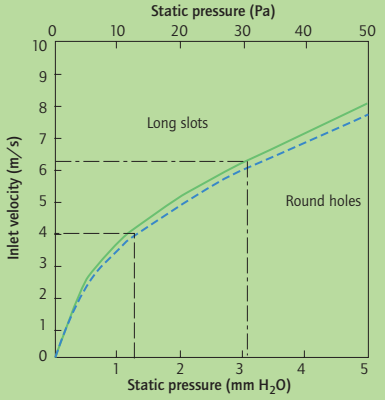


Figure 3. Calculated inlet velocity vs. static pressure



necessary to provide a good air pattern within the building. Easy adjustment is a very important consideration. For typical cross-flow systems, the inlet must be adjusted each time the exhaust rate changes. Even the best operator will not perform this adjustment should it be difficult or cumbersome. A hand winch control is often used. However, there are a number of automatic static pressure controllers on the market which are designed to help the farmer better manage his ventilation air inlets. These controls help to ensure a constant environment and eliminate another chore.

Slot-type air inlet with baffle board

One of the common types of air inlets which is available today is the slot-type air inlet with baffle board. This is probably the most common type of air inlet used today. It is found in most cross-flow (negative pressure) ventilation systems either as a side or centre air inlet. Firstly, be sure you have sufficient air inlet opening to handle the full range of fan capacity. Provide at least 0.33m^2 of inlet opening per 1,000 L/s of air exhausted (1.67 ft^2 / 1,000 CFM). Note that 0.4m^2/1000 L/s (2.00 ft^2/1,000 CFM) is even better.

An air inlet along one sidewall is generally sufficient. Wide barns will require an air inlet along both sidewalls. Be sure to choose an inlet that is compatible with the pen layout. The air inlet should be as continuous as possible. Therefore, you must remember to keep wall fans at least 0.5 meters (20 inches) below the ceiling so that they will not interfere with a side air inlet running the entire sidewall length. A 2.75 meter (9 feet) or higher side wall is desirable for this arrangement. If you are employing two side air inlets, they should be of equal length to guarantee a balanced airflow.

Maintaining negative pressure

In cross-flow systems an inlet air speed of 4-5m/s (800-1,000 ft/min) is desired to promote good mixing and prevent heavier, cooler air from dropping directly on the animal. This air speed is maintained by adjusting the baffle board such that the exhaust fan creates a slight negative pressure within the poultry house. Since a constant incoming air speed is desired, a steady static pressure must be maintained regardless of the number of fans operating (*Figure 2 and 3*). This static pressure should be kept in the range of 1.0-2.5 mm (0.04-0.10 inches) of water gauge static pressure. During cold weather, keep the static pressure at the high end of this range and lower during warm weather. This is due to the fact that cold air is heavier and because of the small amount required we do not gain the mass flow effect as we do in the summer.

Each room must be set individually to obtain the correct air circulation pattern for that room. A smoke generator is beneficial in determining the correct pattern. A simple static pressure gauge will aid you in maintaining the correct air inlet opening or you can install an automatic static pressure controller which controls the baffle board automatically. □