Poultry Housing Tips

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Air Deflectors in Tunnel-Ventilated Houses

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The key to keeping birds cool during the warm summer months is air movement. If enough air is moved over and around a bird the effective air temperature can be reduced by ten degrees or more. This is because as air moves over the bird, heat is removed from the bird's body, making it cooler. So, even though a thermometer in a house may indicate that the air temperature is 85°, with good air movement the birds will eat, gain weight, and perform as if the temperature were 75°.

The effectiveness of fogging and evaporative cooling pad systems is also heavily dependent on air movement. Even the best evaporative cooling system has a limit to how much it can reduce house air temperature. For instance, on a 100° day most growers would be thrilled to get 15 degrees cooling out of their evaporative cooling system. Though 85° is a lot cooler than 100°, without any windchill effect it is still about 15 degrees warmer than what most producers would consider ideal. In houses with fogging nozzles insufficient air movement will not keep fog aloft and will allow it to wet the floor. Though a little moisture on a bird can be beneficial, too much can cause wet litter problems.

Air speed in a tunnel-ventilated house should be between 350 ft./min. and 500 ft./min. to ensure maximum efficiency of evaporative cooling systems as well as wind chill effect. In most drop ceiling tunnel-ventilated houses equipped with the proper number of fans, obtaining the desired air speed does not present a significant problem.

For example, a 400' tunnel-ventilated broiler house requires a minimum 130,000 ft.3/min. of fan capacity to keep the temperature of the air exiting the house to within five degrees of the air entering the house (with only a five degree temperature differential between the two ends of a house, bird performance will not be adversely affected). The average air speed can be determined by dividing the total fan capacity by the cross-sectional area of the house.

\[
\text{House cross-sectional area} = \text{house width} \times \text{average side wall height} \\
= 40 \text{ ft.} \times (7.5 \text{ ft.} + 11.5 \text{ ft.})/2 \\
= 380 \text{ ft.}^2
\]
**Velocity** = \( \frac{\text{fan output}}{\text{house cross-sectional area}} \)

\[ = \frac{130,000 \text{ ft}^3/\text{min.}}{380 \text{ ft}^2} \]

\[ = 342 \text{ ft./min.} \]

Obtaining adequate air speed often presents a problem in short or open ceiling houses. Air speed in open ceiling houses tends to be low due to their relatively large cross-sectional area (the larger the pipe, the slower the flow). For example, a 400' broiler house requires a minimum of 130,000 ft3/min of air moving capacity.

**Cross-sectional area** = \( \text{house width \times average side wall height} \)

\[ = 40 \text{ ft.} \times (7 \frac{1}{2} \text{ ft.} + 16 \text{ ft})/2 \]

\[ = 470 \text{ ft}^2 \]

**Velocity** = \( \frac{\text{fan capacity}}{\text{house cross-sectional area}} \)

\[ = \frac{130,000 \text{ ft}^3/\text{min.}}{470 \text{ ft}^2} \]

\[ = 276 \text{ ft./min.} \]

Short houses tend to be on the low air velocity side because of a lack of fans. For example, a 300' broiler house requires a minimum of 112,000 ft3/min of fan capacity (approximately six 48" slant-wall fans) to maintain uniform house temperature.

**Velocity** = \( \frac{\text{fan capacity}}{\text{house cross-sectional area}} \)

\[ = \frac{112,000 \text{ ft}^3/\text{min.}}{380 \text{ ft}^2 (40' \text{ wide house, drop ceiling})} \]

\[ = 295 \text{ ft./min.} \]

In both cases the speed of the air moving over the birds would not produce sufficient cooling during hot weather.

One possible way to increase air speed would of course be to add an exhaust fan or two. The problem with adding fans is that both the initial and operating costs of the ventilation system in the house would be increased. In the open-ceiling house example, a drop ceiling could be installed, which again would result in a significant increase in cost. But, there is a way to increase air speed that doesn't involve spending a lot of money. All that is required is some curtain material and a little time.

You may have noticed when walking under a rolled up half-house curtain in a tunnel-ventilated house there is a slight increase in air speed. This is because the rolled up curtain temporarily reduces the cross-sectional area of the house. The brooding curtain, in effect, forces the air through a smaller opening, thereby increasing its speed, just as placing your finger over the end of a garden hose increases the speed of the water flowing out of it.

In a 300' drop ceiling house, the rolled up brooding curtain in effect reduces the ceiling height by about one foot. This may not seem like much difference but this small change in ceiling height...
will have a significant effect upon air speed. The example below demonstrates how air velocity under a rolled up brooding curtain would be increased from the 276 ft./min. shown in the first example.

*Cross-sectional area = house width x average side wall height*

\[
= 40 \text{ ft.} \times (6.5 \text{ ft.} + 10.5 \text{ ft.})/2 \\
= 340 \text{ ft.}^2
\]

*Velocity = fan capacity / house cross-sectional area*

\[
= 112,000 \text{ ft.}^3/\text{min.} / 340 \text{ ft.}^2 \\
= 330 \text{ ft./min.}
\]

An air deflector will increase the air speed starting about ten feet in front of the deflector continuing to about 30 to 40 feet behind the deflector. The air speed is increased in front of the deflector because the air actually starts to move under the deflector before it gets to it. After the air flow moves under the deflector it begins to expand back to fill the entire cross section of the house. As the air expands, it slows back down.

Hanging curtain material from the ceiling to within nine feet of the floor in an open-ceiling house with a fan capacity of 148,000 ft.3/min. would increase air speed in the vicinity of the deflector to approximately 400 ft./min., an increase of nearly 25 percent. If the curtains were hung from the ceiling every 40 ft. or so, the increase in air speed would remain nearly constant from the inlet end to the fan end of the house.

Air deflectors can be misused. If they are put in the wrong house or installed improperly they can do more harm than good. It is important to be aware that there is a limit to their use for increasing the amount of air speed. In general, the air velocity under a deflector should not exceed 450 ft./min. If the deflector is dropped too low in an effort to obtain additional air movement over the birds, two problems can be encountered.
First, if deflector curtains are too low, they place a strain on the exhaust fans. This is because deflectors act like restrictions in a pipe. Since it is harder to draw air through a clogged pipe than an open one, the amount of air moved by the exhaust fans will decrease. If the fans move less air, the air will remain in the house longer, leading to an increase in the difference in temperature between the inlet and fan ends of the house. In addition, since the fans have to work harder they will use slightly more electricity. The end result is that the fans may move 30 percent less air and use five to ten percent more power with improperly installed deflectors.

A second problem encountered when deflectors are installed too low is the air may actually "bounce" off the floor and move too quickly back toward the ceiling. In a number of instances, field measurements have shown air speeds under deflectors in excess of 600 ft./min. while the air speed 30' behind the deflectors is less than 100 feet per minute. The net result is areas of extremely high air movement and areas with very little air movement.

These problems can be avoided by simply not lowering the deflectors too close to the floor. Since we do not want to exceed 450 ft./min., the amount of opening that should be below the deflector can be determined by simply dividing your exhaust fan capacity by 400 ft./min. (dividing by 400 ft./min. instead of 450 ft./min. provides a slight safety margin).

\[
\text{Area Under Deflector} = \frac{\text{fan capacity}}{400 \text{ ft./min.}}.
\]

\[
= \frac{130,000 \text{ ft.}^3/\text{min.}}{400 \text{ ft./min.}}.
\]

\[= 325 \text{ ft.}^2\]

The proper deflector height (from floor to bottom of the deflector) can be determined by dividing the recommended area under the deflector by the width of the house.

\[
\text{Deflector Height} = \frac{\text{area under deflector}}{\text{house width}}.
\]

\[
= \frac{325 \text{ ft.}^2}{40 \text{ ft.}}.
\]

\[= 8 \text{ ft. 2 in.}\]

After the deflectors are installed, some fine tuning may be required. Air velocity meters can be used to double check the speed of the air traveling under the deflector to ensure it does not exceed 450 ft./min.. If the air speed is too high, the deflectors should be raised. Conversely, if the air speed is too low, the deflectors can be lowered.
Another method to determine if the deflectors are too low is to check house static pressure. Since the deflectors change the speed of the air in the house, the static pressure will change from the inlet to the fan end of the house. In houses with fogging nozzles, the static pressure 20' down from the end of the tunnel curtain should be between 0.03” and 0.06” and should not exceed 0.08” at the exhaust fan end of the house. In houses with evaporative cooling pads, the static pressure ideally should not exceed 0.08” 20’ from the end of the pads and 0.10” near the exhaust fans. If the pressure is too high at the fan end of the house, the deflectors should be raised until the proper pressure is obtained.

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