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Poultry Housing Tips

Air Speed Distribution in Tunnel-Ventilated Houses - Part 2

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As discussed in Part 1 (Volume 16 Number 4) air speed uniformity and therefore cooling is significantly affected by the smoothness of the side walls in a tunnel-ventilated house. Side wall posts or exposed studs can discourage air from moving along the side wall leading to a variation in air speed between the center and the side wall of a house of 30% or more. Since the relationship between air speed and cooling produced is exponential in nature, a 30% difference in air speed can result in 60% less cooling for the birds near the side walls of a house versus those toward the center of a house. In contrast, air velocity variation in houses with smooth side walls has been shown to be often less than 10%, resulting in significantly more uniform bird cooling than experienced in houses with rough side walls.

The question of course is how to improve air speed uniformity in houses with post construction or those with exposed stud walls. One possible solution for houses with stud wall curtain openings is to simply cover the exposed studs with curtain material or inexpensive plastic sheeting (Figures 1 and 2). To verify the benefit which a smooth side wall has on air speed near a side wall a study was conducted in a 40' X 500' tunnel-ventilated house of 4" X 6" post construction. Air velocity measurements were taken every 20 feet, two and a half feet from the side wall, starting at the brooding curtain to within 20' of the tunnel fans. A 100' X 4' piece of 4 mil plastic sheeting was then placed over the curtain opening starting at the brooding curtain and air velocity measurements were repeated (Figures 1 and 2).

Figure 1. Exposed studs in side wall.

Figure 2. Plastic covering exposed stud wall.

Air velocity near the side wall with exposed studs averaged 350 ft/min while in the center of the house air speed was approximately 550 ft/min. Covering the exposed studs with plastic sheeting increased air velocity near the side wall to 450 ft/min, while air speed in the center of the house decreased slightly to 500 ft/min. The increase in side wall air speed from 350 to 450 ft/min would increase the wind chill effect at 85°F by approximately four degrees (Figure 3).

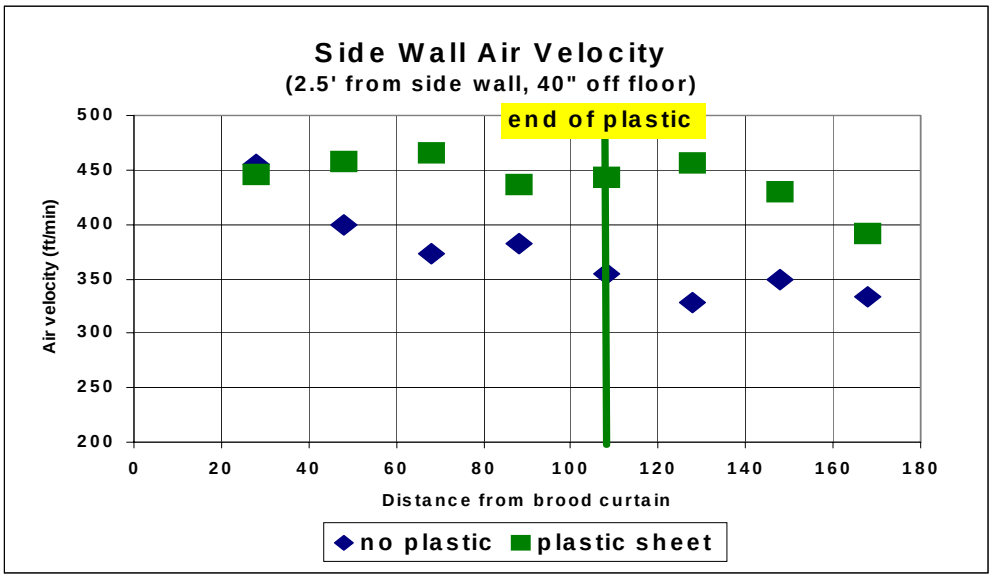

Figure 3. Side wall air velocity with and without plastic

Another advantage of covering the curtain opening with curtain material or plastic sheeting is that it reduces the amount of radiant heat emanating from the curtain during hot weather. Direct sunlight can increase curtain temperature to between 100 and 150°F. The hot curtain can radiate heat to the birds near the side wall much as a pancake brooder radiates heat to young chicks causing an increase in effective temperature. The combination of increased convective cooling and reduction in radiant heating can decrease the effective temperature on the side wall between five and ten degrees during hot weather.

The effect that radiant heat emanating from side wall curtains has on broilers near a side wall can be seen in the below infrared images from a 40' X 500' curtain-sided broiler house of stud wall construction. The images were taken in the late morning when outside air temperature was in the mid eighties. The six-week-old birds near the side wall in Figure 5 are more yellow in color than those near the center of the house (Figure 4) indicating a higher surface temperature. The higher surface temperature is due to a combination of the two aforementioned factors, lower air speed near the exposed stud side wall and radiant heat emanating from the 105°F side wall curtain.

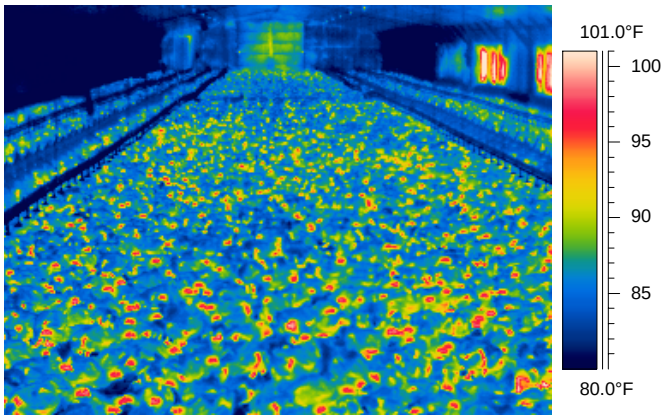

Figure 4. Center of brooding end

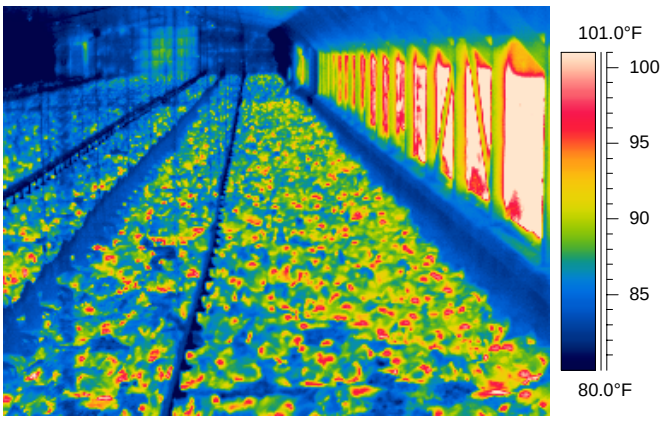

Figure 5. Side wall of brooding end.

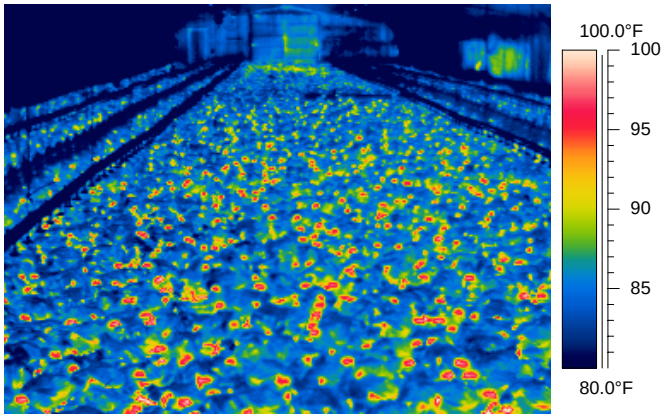

Figure 6. Center of brooding area.

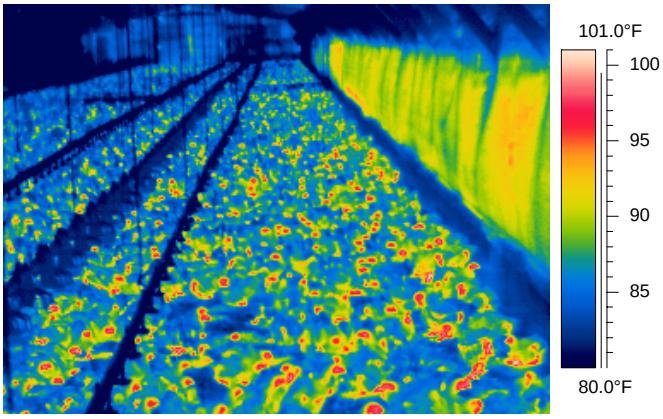

Figure 7. Brooding side wall with interior curtain.

In another house on the farm the producer happened to have an interior curtain on the brooding end of the house in an effort to reduce heating cost during cold weather. The interior curtain not only reduced the amount of radiant heat emanating from the cooler curtain, approximately 90ºF, but also improved air speed along the side wall by making it smoother. The combination of these two factors resulted in slightly cooler birds near the side wall when compared to the house without an interior curtain as indicated by the reduced difference in surface temperature between the birds on the side wall and those in the center of the house (Figures 6 and 7). The effect would have no doubt been greater had the wall been properly insulated which would have eliminated radiant heat and hot air (the curtain was not very tight) from heating the birds on the side wall.

The downside of adding an interior curtain or plastic to a house that has no generator is of course that in case of a power outage, unless a curtain drop is added to the interior curtain or the plastic is quickly removed the birds will die. If the house has a standby generator with an automatic transfer switch the risk would be no greater than any other totally enclosed house.


Figure 8. 4" X 6" post side wall


Figure 9. 4" X 6" post side wall with plastic sheeting.

To see what effect increasing side wall smoothness would have in a house of post construction, a second air velocity uniformity study was conducted in a 40' X 500' curtain-sided house, constructed of 4" X 6" posts five foot on center (Figure 8). Eight air velocity measurements were taken across the width of the house starting at the tunnel fans up to the brooding curtain every 20' with eight tunnel fans operating.

As expected the exposed posts resulted in air speeds near the side wall between 250 and 350 ft/min while in the center of the house the air speed was a little over 500 ft/min resulting in a three fold difference in wind chill effect across the width of the house (Figure 10). As with other houses studied the rolled up brooding curtain did reduce air speed variation in the area 30' past that point. Since the house was equipped with radiant tube brooders located at the peak of the ceiling the heating system had little effect on air speed distribution.

To see how much air speed distribution could be improved if the side walls were smoother a 100' section of one side wall just past the brooding curtain was covered with a six foot tall sheet of 8 mil plastic and air velocity measurements were repeated (Figure 9).

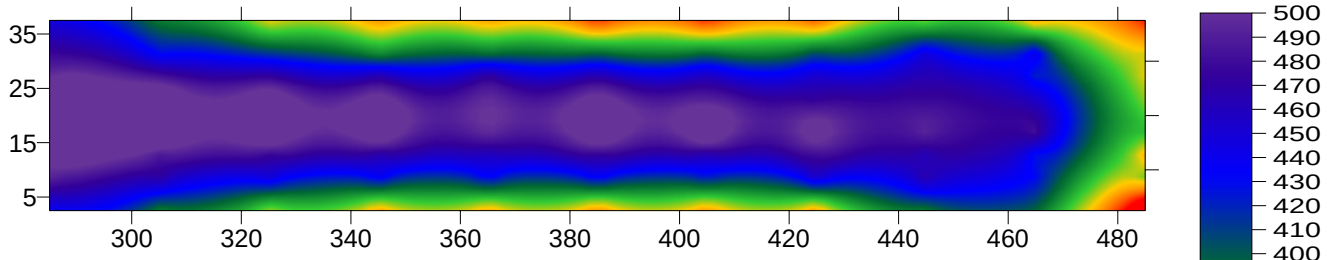

Figure 10. Air velocity profile in house with 4" X 6" posts.

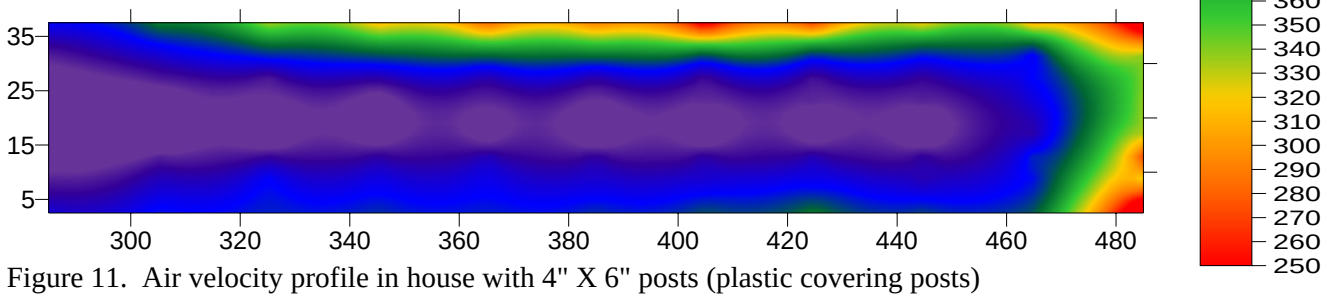

Figure 11. Air velocity profile in house with 4" X 6" posts (plastic covering posts)

The plastic sheeting increased air speed along the side wall from between 250 and 350 ft/min to 400 ft/min or greater on average (Figure 11). Air velocity measurements taken near the side wall past the end of the plastic sheeting, though slower than in the vicinity of the plastic sheeting, did remain relatively high until reaching the first tunnel fan 60 feet away. Overall variation in air velocity from the center to the side wall was reduced to approximately 100 ft/min with the use of the plastic sheeting.

Though installing plastic sheeting from the floor to the ceiling to increase side wall smoothness is not practical in most cases the study did illustrate how cooling along the side wall can be significantly increased if it is made smooth. Producers with curtain-sided houses of post construction may want to keep this in mind if they are considering making their houses totally enclosed to reduce heating costs. Instead of just inserting lumber or insulation material into the existing curtain opening, they may want to consider attaching plywood, OSB, heavy plastic, or some other material to inside surface of the side wall posts and filling the void with blown or batt insulation. Not only will their houses be warmer during the winter, the increased air speed along the side wall as well as the elimination of radiant heat from the curtains will make a significant percentage of their birds cooler during the hot summer months.

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