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Poultry Housing Tips

Increasing Sidewall Height Doesn't Significantly Increase Heating Costs

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There is a common misconception that a poultry house with a higher ceiling will have a significantly higher heating costs than one with a lower ceiling. The truth is that how much it costs to heat a poultry house has much more to do with how well it is insulated and ventilated than how high the ceiling is. For instance, did you know that for a modern totally enclosed broiler house increasing the sidewall height from eight to ten feet would increase heating costs by less than 5%. This is because that though increasing the sidewall height by 20% would increase heat loss through the sidewalls by 20%, the sidewalls represent a very small percentage (6%) of the total heat loss from a poultry house (Figure 1). So, increasing the relatively small amount of heat loss through the sidewalls by 20% or even more would not have a big impact on the total cost of heating a poultry house. By far the biggest source of heat loss is ventilation, representing approximately 70% of the total cost of heating a totally-enclosed poultry house, and increasing the sidewall height would have no effect on the amount of fresh air birds require.

This of course is not to say that having a higher ceiling can't be responsible for higher heating costs. For instance, open ceiling houses (houses without an attic space) will tend to have a 10% or greater heating costs than dropped ceiling houses, not because the ceiling is higher but rather because the insulation value is a half to a third that of a dropped ceiling house. Furthermore, an open ceiling house tends to have a greater surface area than a dropped ceiling house and gaps between insulation boards and at the peak of the house tend to make an open ceiling house looser, further increasing the heat loss from the ceiling. But in a dropped ceiling house if the sidewall height is increased, the ceiling doesn't change and therefore heat loss through the ceiling remains the same. The only thing that contributes to higher heating costs is the additional heat loss through the sidewalls, which noted previously is minimal.

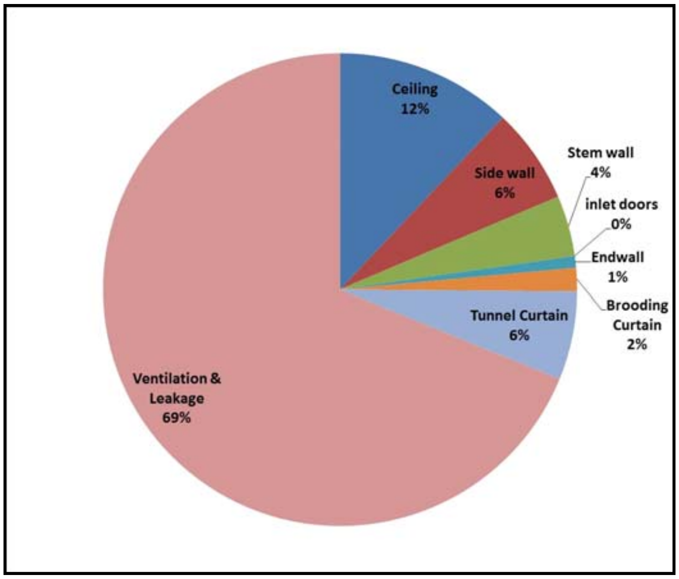

Figure 1. Heat loss from a modern totally-enclosed poultry house.

There are actually a number of benefits of having a higher ceiling during cold weather. First, coverage area of radiant heaters increases as ceiling height increases. When a radiant heater such as a tube or a brooder is installed at a relatively low height, floor temperatures will tend to decrease rapidly as you move away from a brooder reducing the number of chicks in a house that receive some measure of radiant heat (Figure 2). Conversely, when installed high above the floor, coverage area is increased and floor temperatures tend to decrease more slowly as you move away from the brooder or tube heater (Figure 3). In wider houses, it can be a challenge to install radiant heaters at an optimal height. For instance, unlike with traditional 40' wide houses where a tube heater can be installed at the peak of the ceiling thus maximizing the distance between the heater and the floor, in houses over 50' in width two rows of heaters are often required to provide adequate floor heating across the width of the house. The problem is that when two rows of tube heaters are installed in a house the installation height may only be 8' above the floor where 10' to 14' would be considered ideal. The relatively low mounting height significantly reduces the coverage of the tube radiant heaters and can lead to fairly high floor temperatures directly under the tube heaters. Having a sidewall that is a foot taller in this situation could help to improve floor conditions across the width of a wide house.

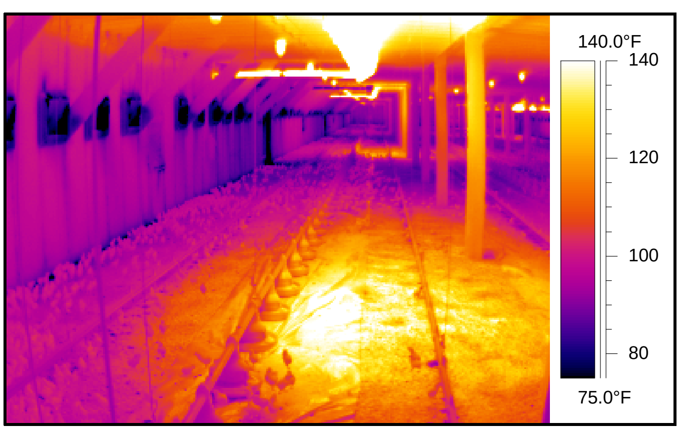

Figure 2. Radiant tube 8' installation height.

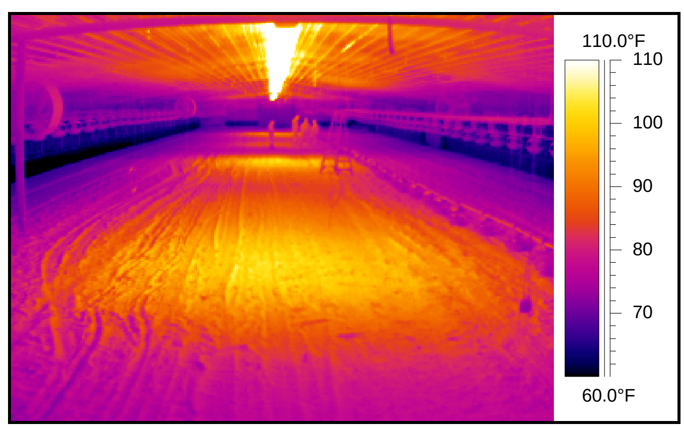

Figure 3. Radiant tube 14' installation height.

It is also important to realize that as ceiling height decreases, bringing in fresh air during cold weather without chilling the birds becomes more difficult. During cold weather we use the air space above the birds as essentially a mixing chamber. Warm air produced by a house's heating system as well as by the birds rises and collects near the ceiling. Cold outside air entering through sidewall inlets moves through the warm air near the ceiling before moving down to floor level. The larger the volume of warm air near the ceiling, and the greater the amount of time the air spends traveling through warm air before moving down the floor level, the less likely the birds will be chilled by the cold, fresh air brought into the house. In houses with very short sidewalls it can be a challenge to get the incoming air throughly heated before moving down to floor level simply because there isn't much time to do so. Think of it this way. You have a house with a five-foot-tall sidewall, it is 20ºF outside and you have seven-day-old chicks. The minimum ventilation fans come on and the cold air enters the house just a few feet above the chicks' heads. It quickly moves through the relatively small pocket of hot air near the ceiling and arrives at the floor in manner of seconds. Though the incoming air has had some chance to warm up it can still be relatively cool when it arrives at the floor. Now, on the other extreme let's say you had a house with a 10' sidewall. The distance between the incoming cold fresh air and the chicks will doubled and there is now a larger pocket of warm air collecting at the ceiling. The distance the air will travel before moving down to chick level increases resulting in warmer air arriving at the floor. The combination of these factors decreases the likelihood that the birds will be chilled when cold, fresh air is brought into the house (Figure 4).

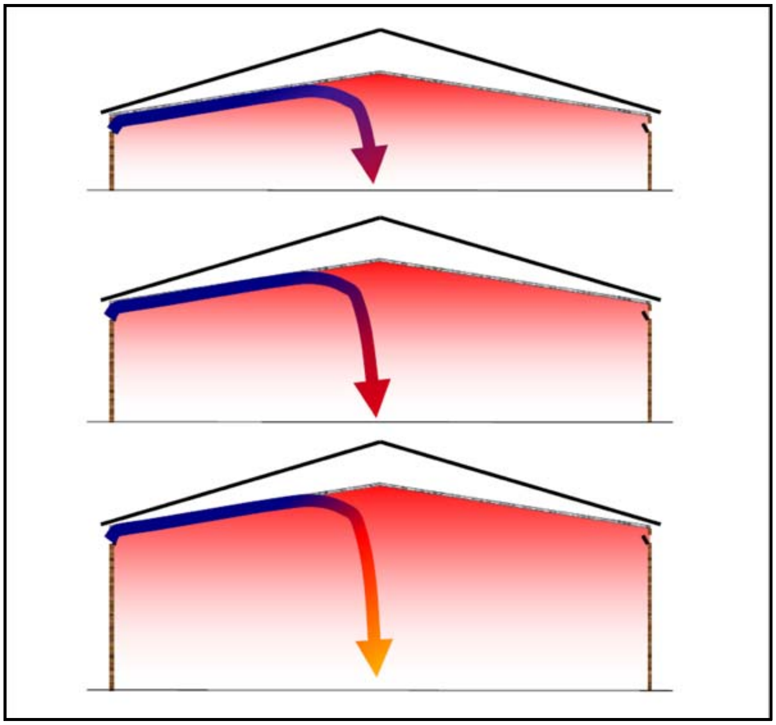

Figure 4. Warming of incoming air vs. Sidewall height.

On a related point, the larger the volume of air there is in a house the less the house temperature will decrease when the minimum ventilation fans turn on. Minimum ventilation rates are essentially determined by the number and size/age of birds in a house, not by house volume/size. Therefore, a house with 20,000, two-week-old birds will require roughly the same minimum ventilation rate whether the sidewall is 5' tall or 10' tall. But, whether the sidewall is 5' or 10' tall will have a significant effect how much the house temperature will decrease when the fans come one. For instance, let's say we had two 40' X 500' houses, one with a 5' sidewall and the other with a 10' sidewall. There are two-week-old birds in the houses and it has been determined that two 36"fans should operate, two minutes out of five. Another way to look at it that we need to bring in roughly 40,000 cubic feet of air every five minutes (10,000 cfm per fan X two fans X two minutes) to maintain the desired level of air quality. Assuming a flat ceiling, there is 100,000 cubic feet of air in the house with the 5' tall sidewall and 200,000 cfm of air in house with the 10' tall sidewall. After the minimum ventilation fans have operated for two minutes, approximately 40% of the warm air in the house with the 5' sidewalls would have been replaced with cold outside air resulting in a dramatic decrease in house temperature. In the house with the 10' sidewall only 20% of the air in the house would have been replaced during the same two-minute period resulting in half as much of a decrease in house decrease. The fact is that house temperatures tend to be more stable in houses with higher ceilings than those with lower ceilings.

It is also important to note though the house with the lower sidewall had a greater air exchange rate (40% vs 20%), the air would not necessarily be "fresher." During cold weather we are not necessarily looking to exchange the air in a house, rather to dilute the stale air in the house with fresh air to maintain a reasonable level of air quality. Both houses would have had the same amount of moisture, carbon dioxide, ammonia, dust, etc. being produced because the number of birds in both houses would be the same. The house with the lower sidewall (lower volume) would have needed to have a higher air exchange rate because the concentration of moisture (relative humidity), ammonia, carbon dioxide, etc. would have been greater due to the fact that the volume of air into which the moisture, carbon dioxide, ammonia, etc would have been smaller than in the house with the taller sidewalls (higher volume). The average air quality over time in both houses would be similar, but variation in air quality as is the case with temperature would have been greater in the house with the lower sidewalls than in the house with higher sidewalls.

Now of course there are down sides to having a house with taller sidewalls, the most significant of which is lower air speeds when tunnel ventilating. The taller the sidewalls, the larger the cross-sectional area of a house, the lower the air speed will be when the house is in tunnel ventilation mode. Increasing the sidewall height 20% would roughly increase the cross-sectional area of a house by 20% which would result in a corresponding reduction in air speed of 20%. To maintain the same level of bird cooling in a house, the tunnel fan capacity would have to be increased by 20%.

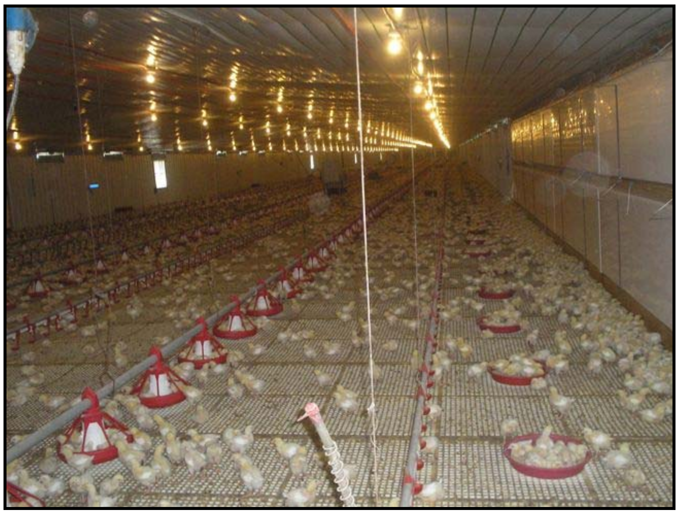

Figure 5. Low sidewall in a tropical climate.

Figure 6. High ceiling in a relatively cold climate.

Therein lies the challenge. Higher ceilings are advantageous when it comes to maintaining optimal conditions during cold weather while lower ceilings are more advantageous during hot weather when tunnel ventilating. This is fact can be seen in average ceiling heights seen around the world. For instance, in tropical countries it is not uncommon to find houses with ceiling heights of six to seven feet while in cold climates houses where temperatures rarely climb above the mid eighties ceiling heights of 10' to 12' are not uncommon. Poultry houses in more temperate climate tend to fall somewhere between the two extremes because a balance must be met between cold and hot weather ventilation objectives.

The challenge in more temperate climates is to keep in mind that higher ceilings do not result in significant increases in heating costs and in fact offer a number of advantages during cold weather. In addition to what has already been noted, a higher ceiling makes it easier to clean out a house, spread shavings, and catch the birds because equipment would be further from the floor. Fitting sidewall inlets above the often limited space above tunnel doors would also prove to be easier with slightly taller sidewalls. Lastly, it is important to realize that lighting uniformity improves as sidewall height increases. Though obviously having a 12' sidewall could make it very expensive to keep birds cool during hot weather, adding six inches or a foot to sidewall height to many poultry house designs could prove beneficial during cold weather without substantially reducing a grower's ability to keep their birds cool during hot weather.

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