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Poultry Housing Tips

Radiant Brooder Coverage Area - Part 2

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A foot-candle is a measure of light intensity and is defined as the amount of light (lumens) per square foot. A lumen is a measure of the light output of a light bulb. For example, an eight-watt LED produces approximately 800 lumens of light. If those 800 lumens are distributed over a 100-square-foot area, the average light intensity would be eight foot candles (800 lumens ÷ 100 square feet).

How does this apply in a poultry house? Consider a 40' × 250' brooding area equipped with 40, eight-watt LEDs. The total light output would be 32,000 lumens (800 lumens per bulb × 40 bulbs). If this light were distributed evenly across the floor, the average light intensity would be 3.2 foot candles (32,000 lumens ÷ (40' × 250')). Now consider installing ten, 27-watt LEDs, each producing 3,200 lumens. Ten bulbs × 3,200 lumens also equals 32,000 lumens. Dividing 32,000 lumens by 10,000 square feet again results in an average light intensity of 3.2 foot candles.

Although the average floor light intensity is the same in both cases, the uniformity of light would likely be very different. Using fewer, higher-intensity LEDs would tend to create areas of excessive light along with areas of insufficient light. Therefore, when designing a lighting system, not only is the total number of lumens installed important, but also how those lumens are distributed is of equal importance...a concept we should not forget when designing a heating system.

A heating system for a broiler house is typically sized based on its ability to deliver a certain number of BTUs/hr per square foot of floor space. Depending primarily on climate and house construction, brooding area heating requirements for a broiler house typically range from 40 to 80 BTUs/hr/ft². For example, if a brooding area measures 50' × 250' and it is determined that a heating system must be capable of suppling at least 50 BTUs/hr/ft² to maintain proper brooding temperatures on the coldest temperatures ever to be expected, the total capacity of the heating system should be at least 625,000 BTUs/hr (50' × 250' × 50 BTUs/hr/ft²). Now, technically, a single 625,000 BTUs/hr-forced air-furnace could be installed; however, heat distribution would likely be poor, with some areas receiving too much heat and others too little. Creating uniform conditions would be much easier if four smaller 156,250-BTUs/hr forced-air furnaces were used in place of the single larger heater.

Using radiant brooders presents another challenge related to heat distribution. A modern radiant brooder heats a house in two important and very different ways: it produces hot air, which helps maintain proper brooding temperatures, and radiant heat, which helps to warm the floor and chicks above ambient air temperature. Approximately 45% of the heat produced by a radiant brooder is in the form of radiant heat, while 55% is in the form of hot air. As a result, when designing a heating system that uses radiant brooders, it is important to ensure that both the hot air and the radiant heat produced by the brooders are distributed evenly throughout the brooding area.

Like forced air heating systems, radiant brooder heating systems are often designed by simply dividing the total desired heating system capacity (BTUs/hr) required by the heat output of a single brooder. For example, if a 50' × 250' area required 625,000 BTUs/hr of heating capacity (50 BTUs/hr*ft2), the number of radiant brooders needed would be calculated by dividing 625,000 BTUs/hr by 40,000 BTUs/hr (typical capacity of a radiant brooder), which would be 15.6, or 16, brooders. While this approach may provide enough heat to maintain proper air temperatures, it may not provide sufficient radiant floor coverage for all birds or ensure it is distributed relatively uniformly throughout a house.

If a typical 40,000-BTUs/hr radiant brooder, installed at a height of six feet, has an effective

radiant coverage area of approximately 300 square feet (Figure 1) (Poultry Housing Tip – Vol. 38, No. 1), then 16 brooders would provide usable radiant heat over 4,800 square feet, or 38% of the 50' × 250' brooding area. If installed at a height of five feet, the effective coverage per brooder would be reduced to 255 ft², decreasing total coverage to 4,080 ft² (33%). Conversely, if the brooders were raised to seven feet, the effective coverage per brooder would increase to 365 ft², increasing the total coverage area to 5,840 ft² (47%). The greater the radiant coverage area, the greater the number of birds that can potentially benefit from the radiant heat produced by the brooders.

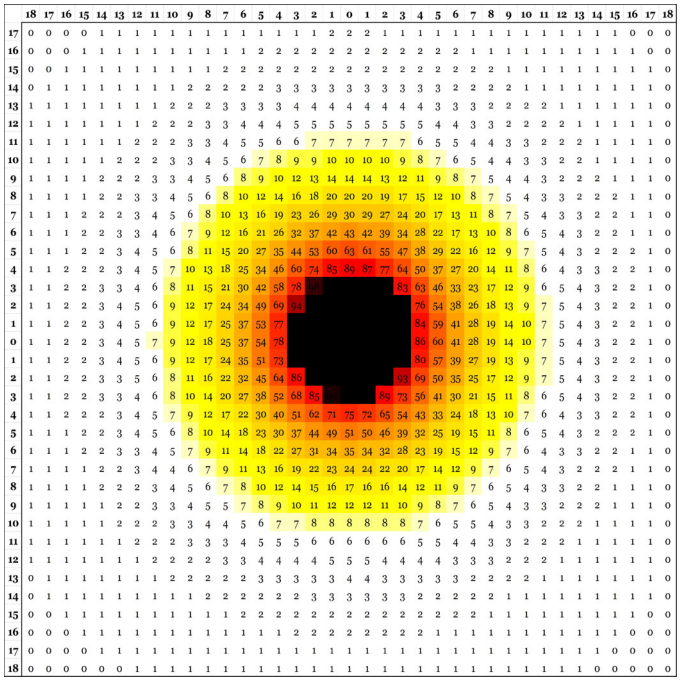

Figure 1. Radiant heat coverage area of 40,000-BTU/hr radiant brooder installed 6' above the floor

It is difficult to determine the precise optimal amount of floor area that should be covered by radiant heat because there are many variables that must be considered, including house construction, brooding temperatures and relative humidity, minimum ventilation system design and operation, bird density, and climate. That said, in moderately cool climates it is generally believed that 40 to 60% of the floor area would ideally receive between 10 and 100 BTUs/hr/ft² of radiant heat (Poultry Housing Tips Vol38n1), assuming proper brooding air temperatures are maintained. Extremely cold climates may benefit from a higher percentage, while tropical climates may make do with lower percentages.

It is important to note that it is not necessary for the entire floor area of a house to receive significant amounts of radiant heat when proper brooding temperatures are maintained. Not all chicks or birds require the same thermal conditions. When "warm room" brooding is used, radiant brooders are intended to provide warm areas that chicks can access if they desire additional heat. The areas should be generally large enough to be able accommodate a large number of the chicks if conditions warrant. Likewise the area not covered by radiant heat should be large enough so a large percentage of the chicks can avoid receiving additional heat.

The benefits of radiant heating systems depend heavily on brooder placement. For example, if all radiant brooders are positioned along the centerline of a house, the theoretical coverage may be 40%. However, birds near cooler sidewalls or end walls—those most in need of supplemental radiant heat—may fall outside the effective radiant zone and receive little or none. As a result, not only is the percentage of floor area within the effective radiant heating zone an important design consideration, but how individual brooders are distributed throughout the house is of equal, if not greater, importance.

Radiant brooder positioning within a house is also of importance when it comes to maintaining proper litter moisture and air quality. By heating the floor directly with radiant heat, a significant amount of litter drying will occur. The lower the litter moisture level, the lower the potential for ammonia generation. As a result it is of benefit that those areas of a poultry house that are prone to wet litter i.e, drinker lines, side walls, end walls can benefit from radiant floor heating (Figure 2).

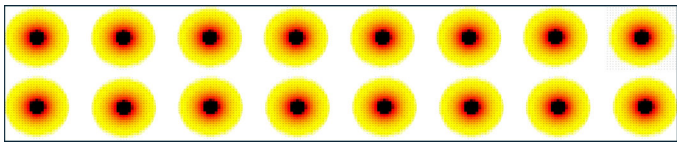

Figure 2. 50' X 250' brooding area with 16, 40,000-BTU/hr radiant brooders in two rows positioned 10' from the side walls, end wall, and brooding curtain.

In short, being able to optimize brooding conditions during cold weather is not determined by total heating capacity alone, but also by how evenly that radiant heat is delivered to the chicks and floor. Proper placement and spacing of radiant brooders ensures uniform hot air and radiant floor heating, allowing birds to self-regulate their comfort, and helps manage litter moisture and air quality—making distribution just as important as BTUs/hr installed.

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