Minimum Ventilation to Maximise Broiler Farm Performance

Ing. Winfridus Bakker
Cobb-Vantress

Available Types Of Ventilation Systems
Simplified

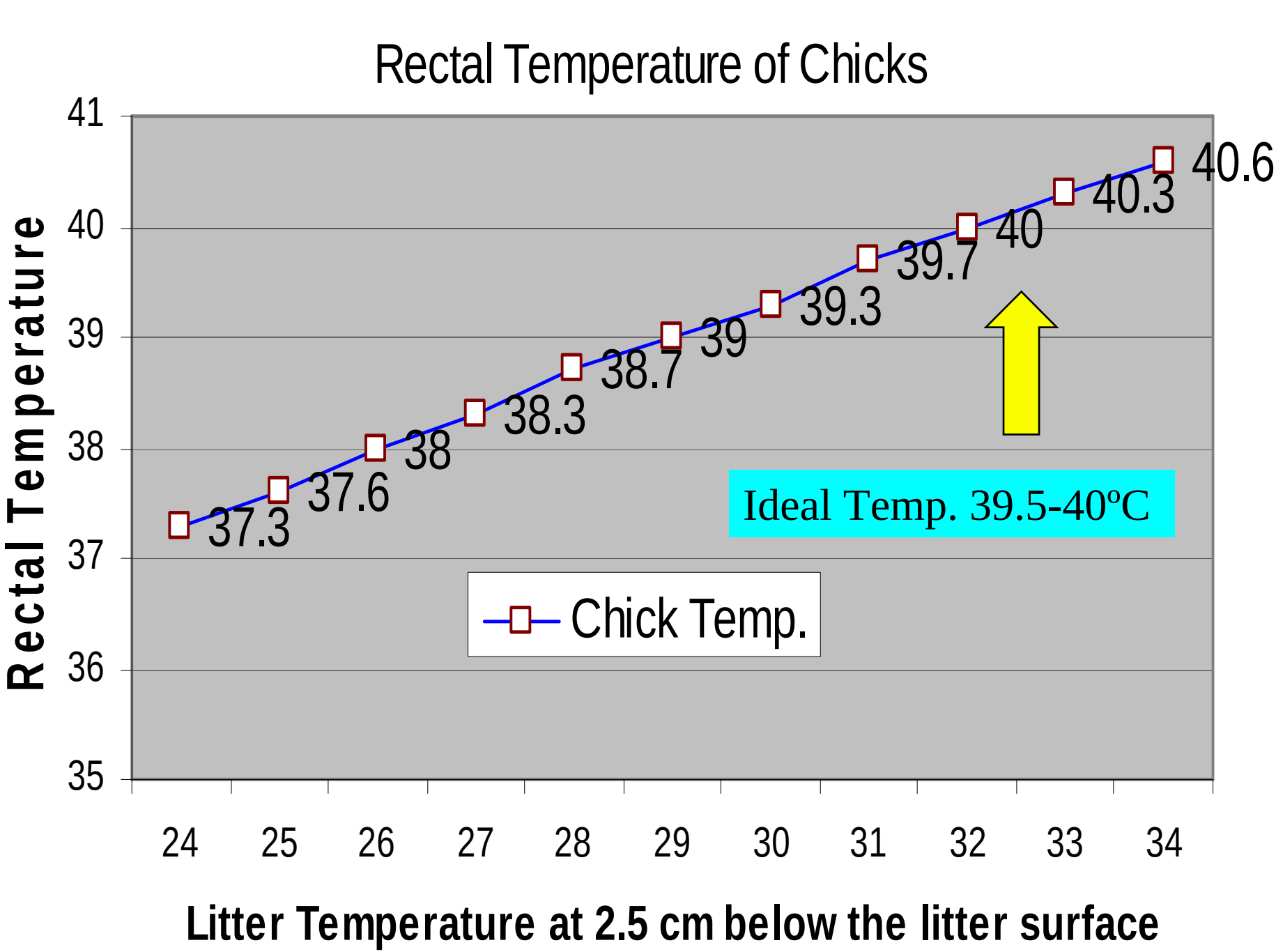
- Natural ventilation system where the house is open.
- Positive pressure system for open and closed houses.
- Negative pressure system, by far the best design and the most efficient and economical for any poultry operation world wide.

Influence of ambient Temperature on the Mortality of Chicks in 1st wk.

Temp. in ºC	27.5	28.5	30	31	32
% Mort.	7.00	3.00	0.92	0.19	0.26
Temp. in ºF	81.5	83.3	86	87.8	89.6

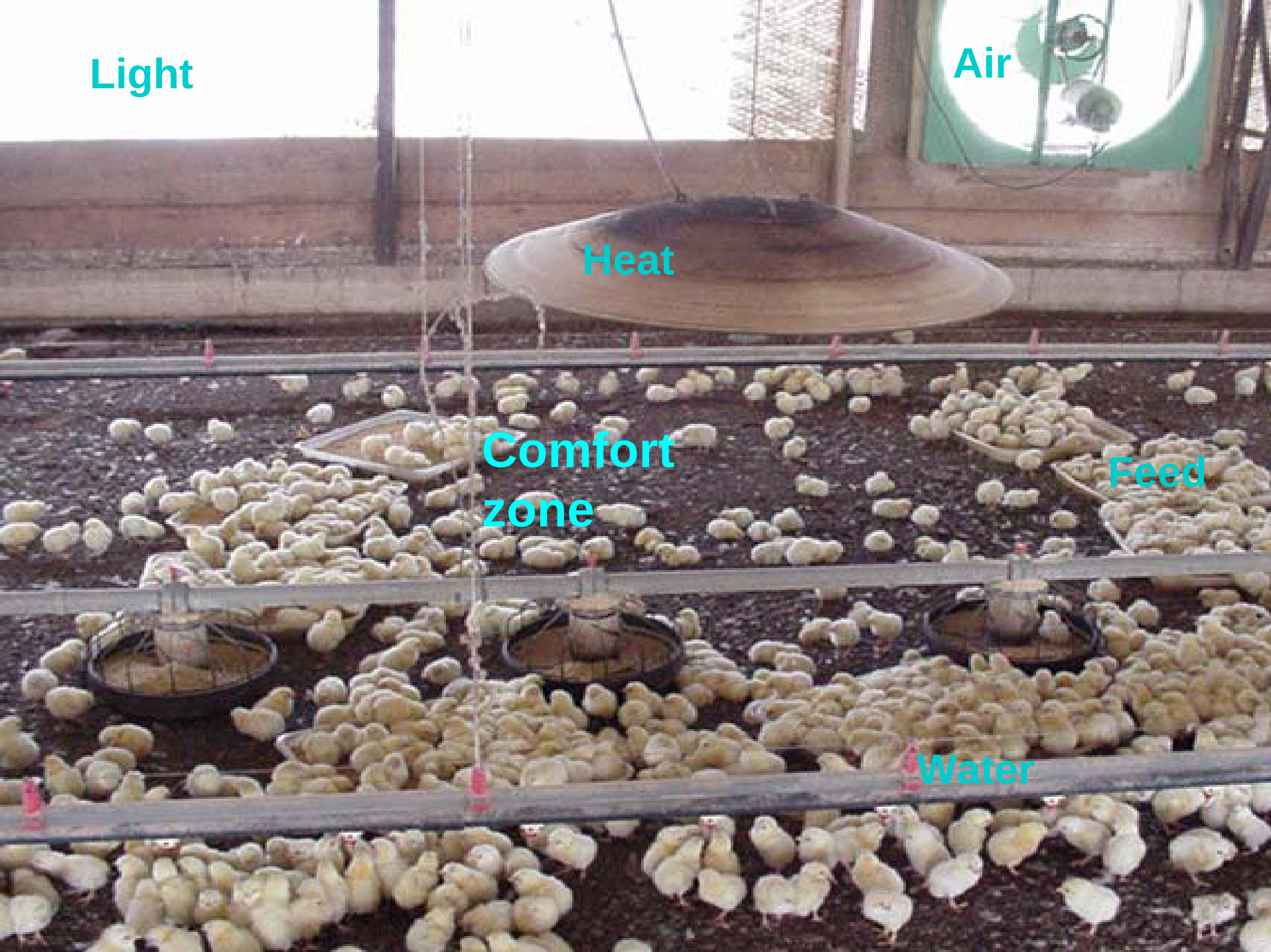
Behavior of Chicks First Few Days

- The chicks behave normally when the rectal temperature is between 39.5 and 40.0ºC.
- When the temperature is lower the chicks will huddle together.
- When the temperature is too high the chicks first start making a lot of noise, then open their beaks to pant. Wings will drop and the chicks will cry louder and louder. If the temperature continues to rise they will go unconscious and die when the rectal temperature gets to 44ºC.

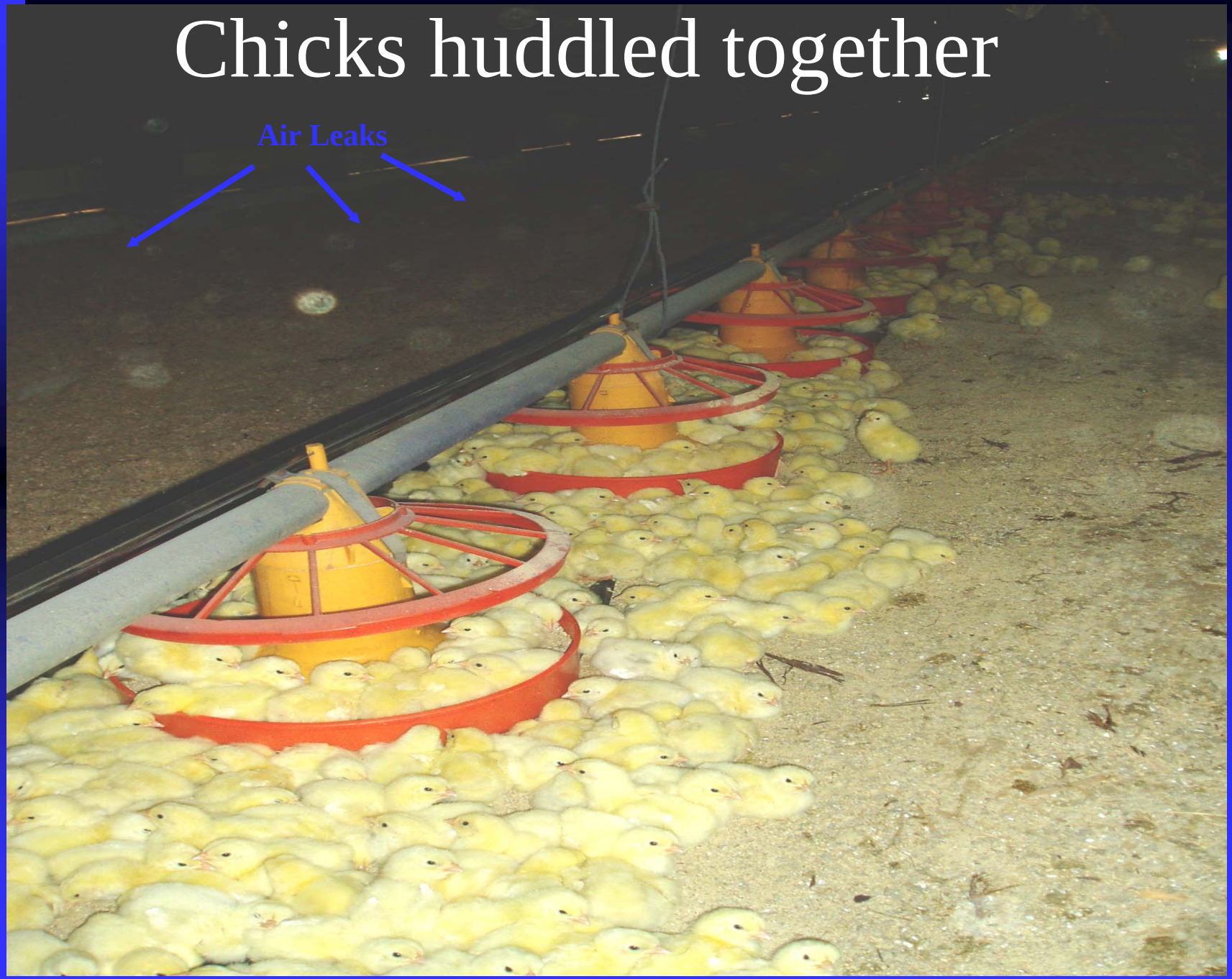

Rectal Temperature of Chicks
Rectal Temperature
41
40
39
38
37
36
35
37.3
37.6
38
38.3
38.7
39
39.3
39.7
40
40.3
40.6
Ideal Temp. 39.5-40ºC
Chick Temp.
24
25
26
27
28
29
30
31
32
33
34
Litter Temperature at 2.5 cm below the litter surface

How to take temperatures of Chicks

- Chicks that are smaller tend to have some lower temperature at hatch.
- If the navel temperature is taken subtract 0.5ºC compared to rectal temperatures (39.5-40ºC).


Light
Air
Heat
Comfort zone
Feed
Water

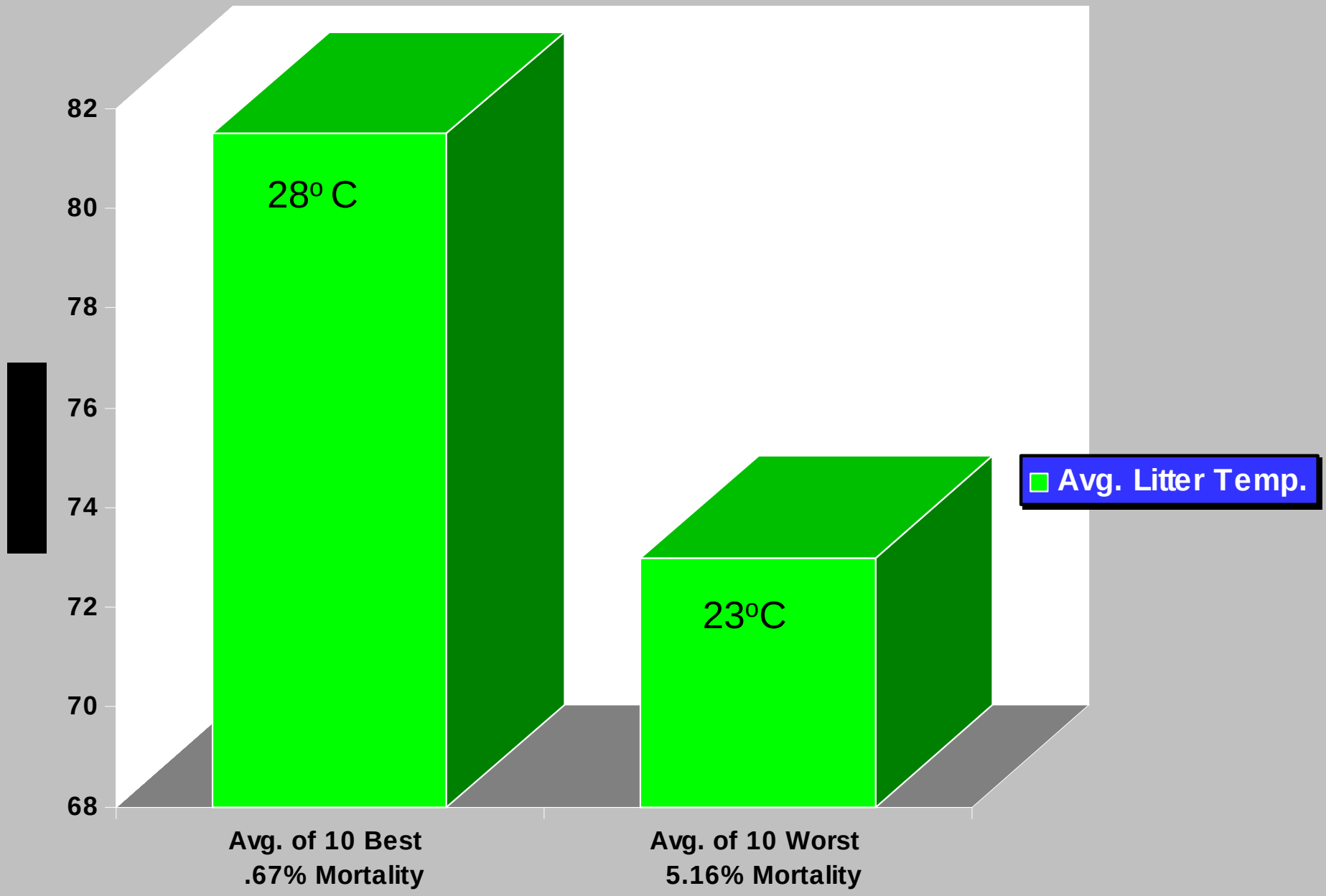
Chicks huddled together



LITTER TEMP. EFFECT ON 7-DAY MORTALITY

- Arkansas integrator study
- 3,600,000 birds placed during December
- Temperatures taken at placement
  - Litter Temp. Taken 2.5 cm Into Litter
- Compared trends with 7-day mortality
- Compared 10 best vs 10 worst 7-day mortality
- Conclusion: higher temperature correlates with lower mortality

Arkansas Integrator Study
10 Best vs 10 Worst



Litter Temperature

- Study conducted in Holland during winter of 2003-2004.
- Study conducted over 200 broiler houses.
- Study conducted over 4,500,000 chickens.
- Litter temperature measured at placement.
- Litter temperature correlated against daily gain and feed conversion.

Floor Temperature

Floor Temperature ºC	Feed Conversion	Daily gain in grams
20 ºC - 68 ºF	1.52	50
22	1.51	50.6
24	1.50	51.2
26	1.49	51.8
28	1.48	52.4
30	1.47	53.0
32 ºC - 90 ºF	1.46	53.6
Diff. 20-32ºC	0.06	3.6

Floor Temperature

- How hot? 40ºC (Litter under brooder)
- How hot ? 32ºC (Litter temperature whole house with heaters)
- First 5 days is critical time (chick body temperature should rise to 40ºC)
- Why?
  - Health/7 day mortality
  - Feed intake/performance

Chilled Chicks = Lower Weights

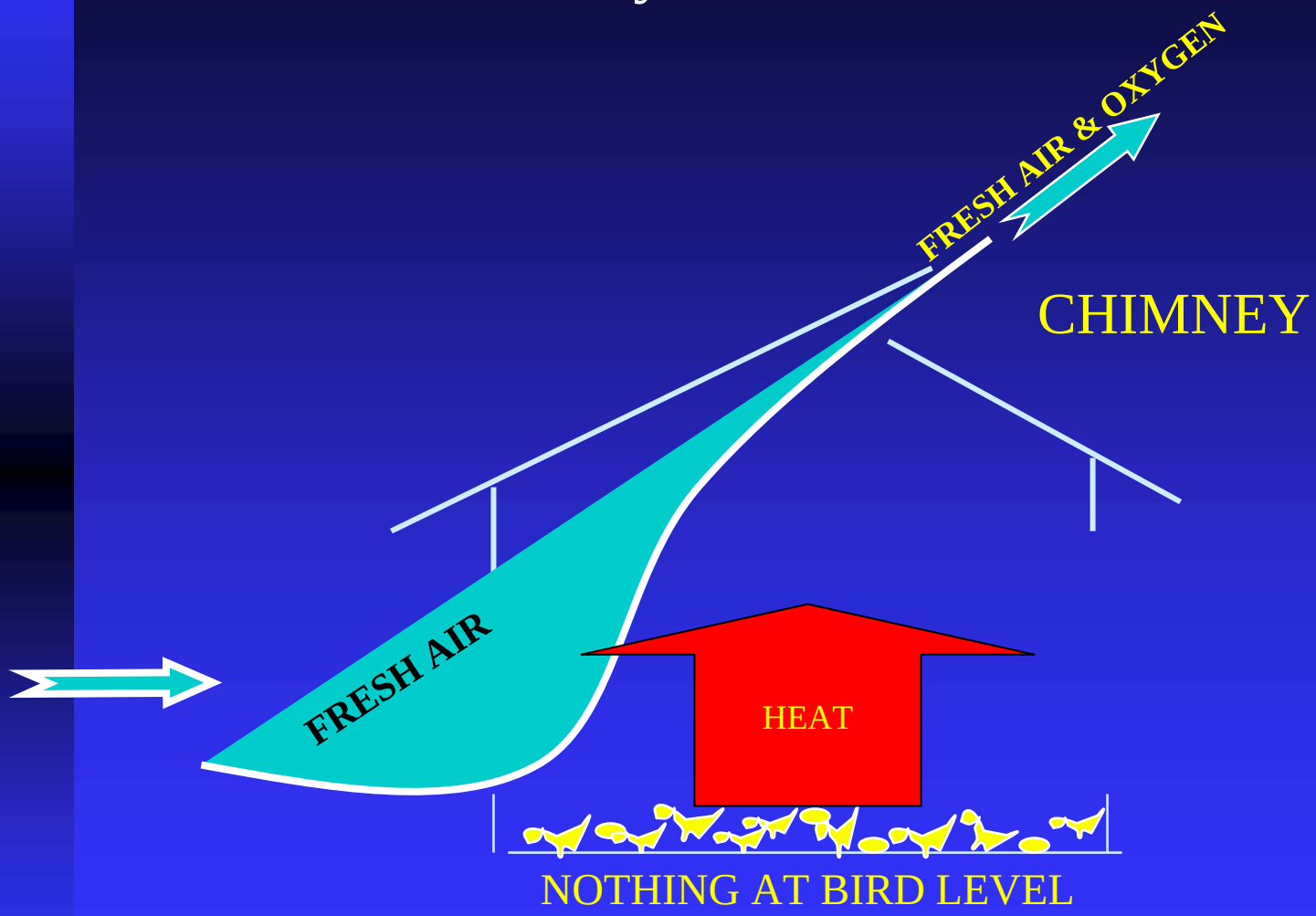
- University of GA study
- Cold stress chicks for just 45 minutes at placement.
  - 12.8 °C= 55 ºF cold environment
- Banded and mixed control and stressed chicks.
- Cold stressed chicks were significantly lighter (109 grams = 0.24 lbs) at 35 days of age.

- **More critical with small chicks or slightly dehydrated chicks (increased surface to weight ratio).**

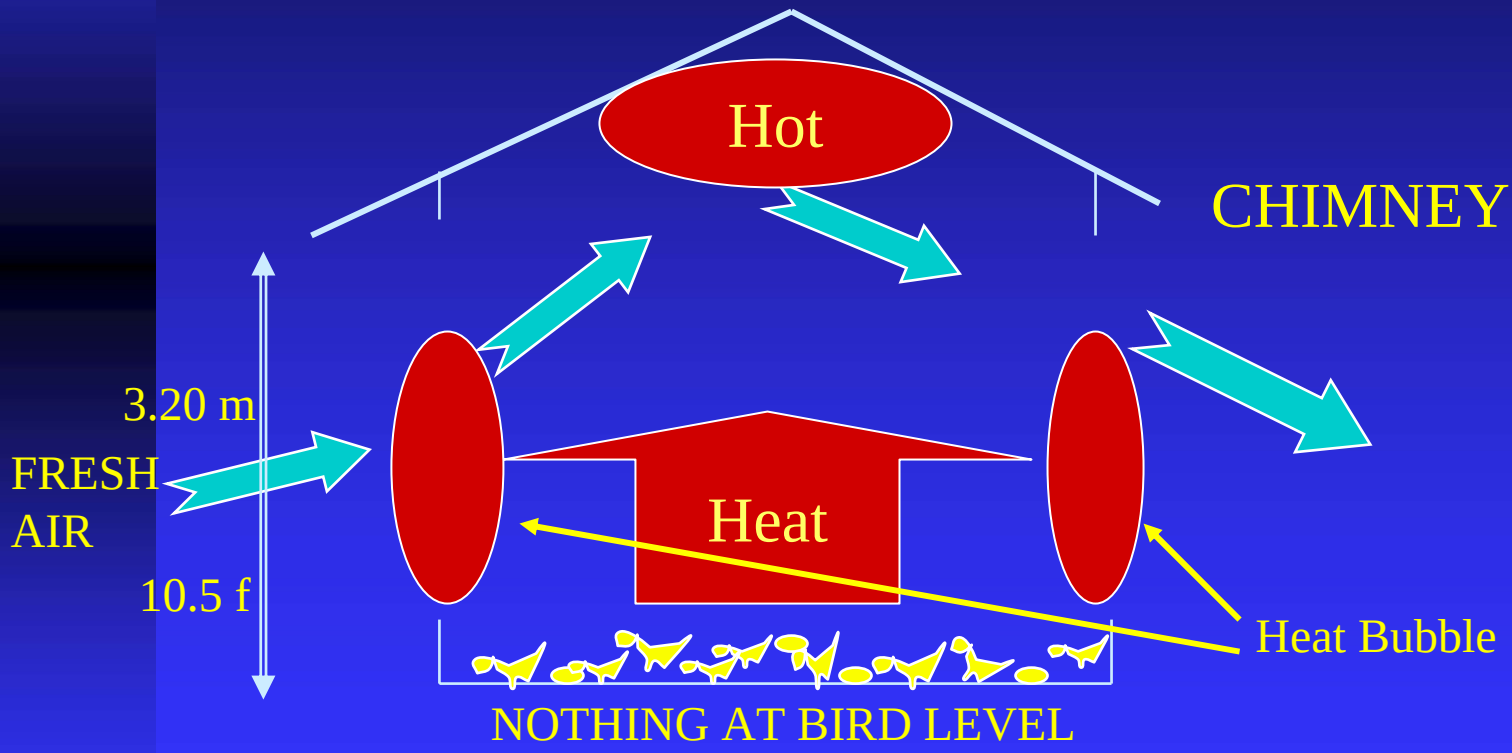
Effect of brooding temperature on broiler performance to 42 days

Brood temp.	BW (g)	FCR	Mortality (%)
29.4-32.2ºC (85-90ºF)	2267 (5 lbs)	1.71	2.08
23.9-26.7ºC (75-80ºF)	2219 (4.89)	1.77	4.17
21.1-23.9ºC (70-75ºF)	2149 (4.74)	1.82	7.08

Early House Design Open Top Chimney
No Air Velocity Across Birds On Floor

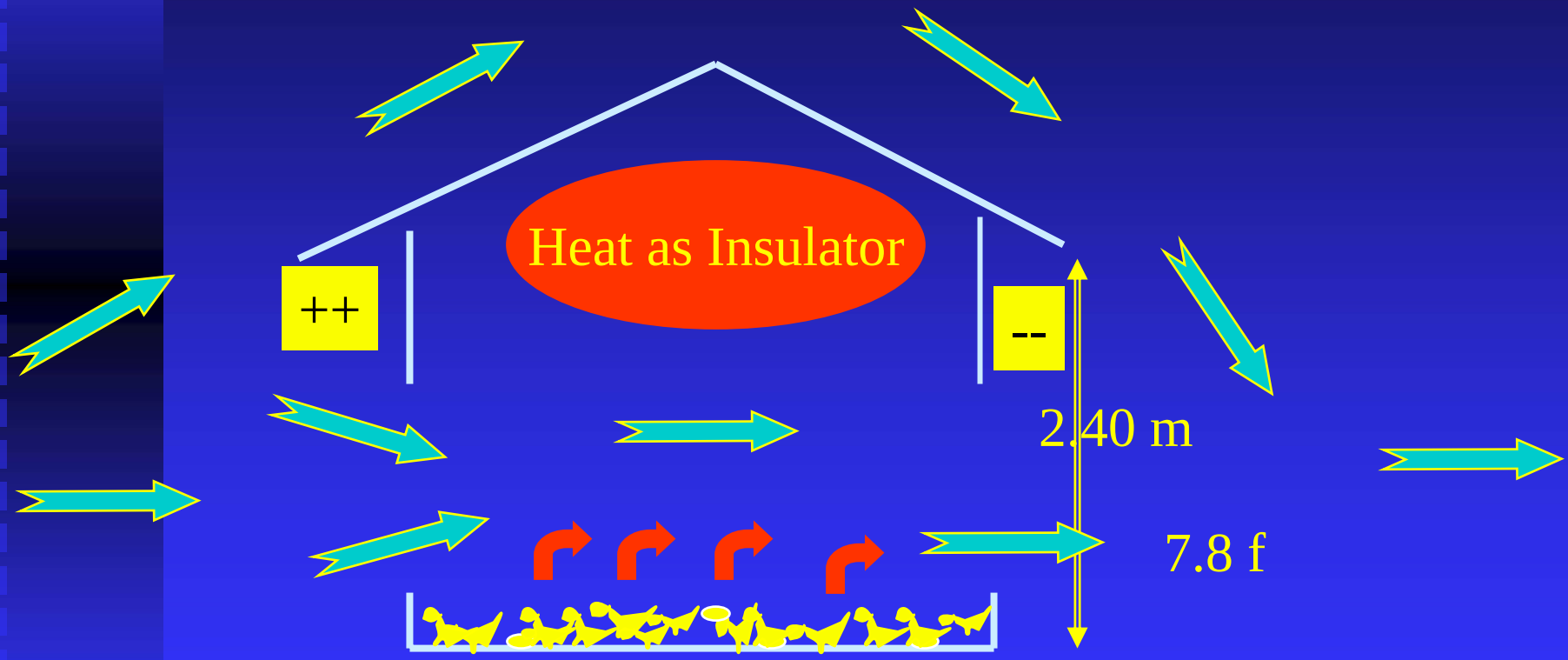


High House Design Open Sidewalls Because Of Heat Up Lift No Air On Floor



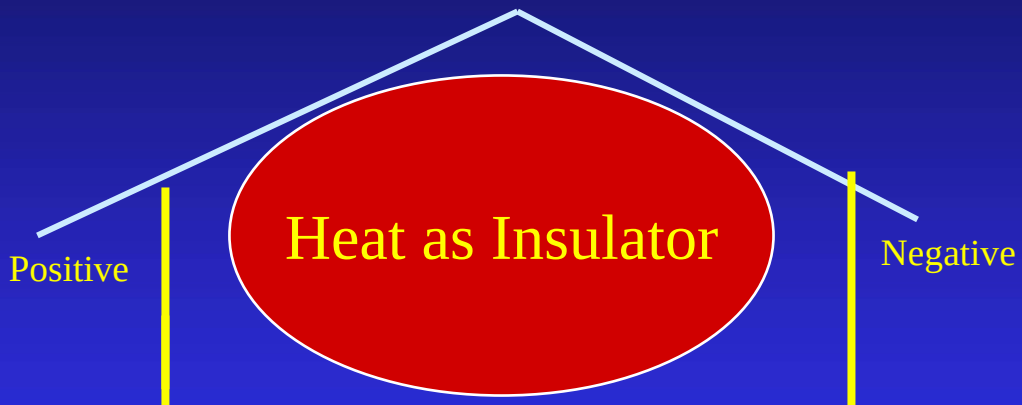
Present House Design

House height is determined by height of machines that need to enter to harvest birds, clean out the house etc.



Ideal side house opening gives air restriction for entering. Opening on opposite site is 5 times inlet opening.

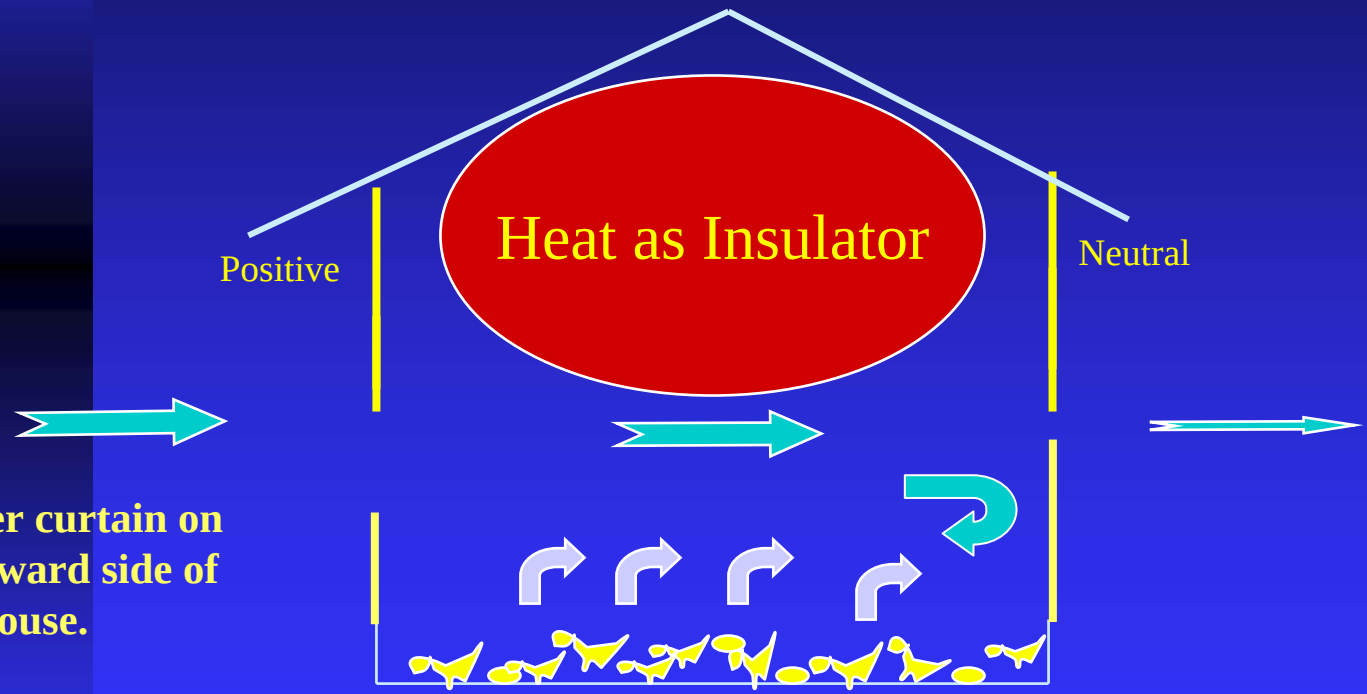
Improved House Design With Drop Curtain Sidewalls At Top Of Opening For Natural Ventilation



Higher curtain on windward side of the house.

To increase air exchange in the house without high air velocity across birds.

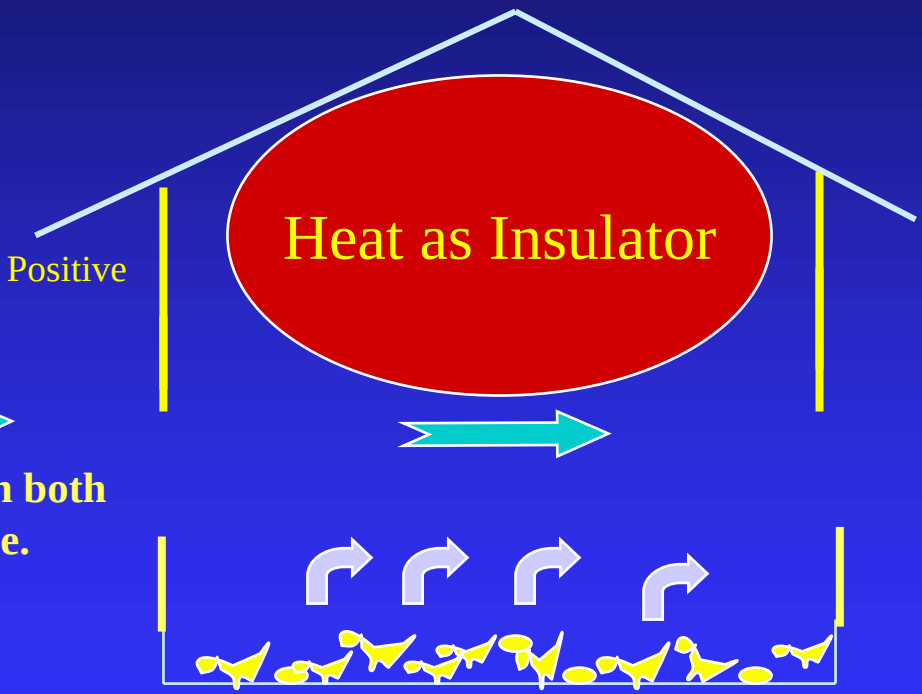
Improved House Design With Drop Curtain Sidewalls At Top Of Opening For Natural Ventilation



Lower curtain on windward side of the house.

To decrease air exchange in the house without high air velocity across birds.

Improved House Design With Drop Curtain Sidewalls At Top Of Opening For Natural Ventilation



Curtains even on both sides of the house.

To increase air exchange in the house and higher air velocity across birds.

Poultry House Ventilation Systems

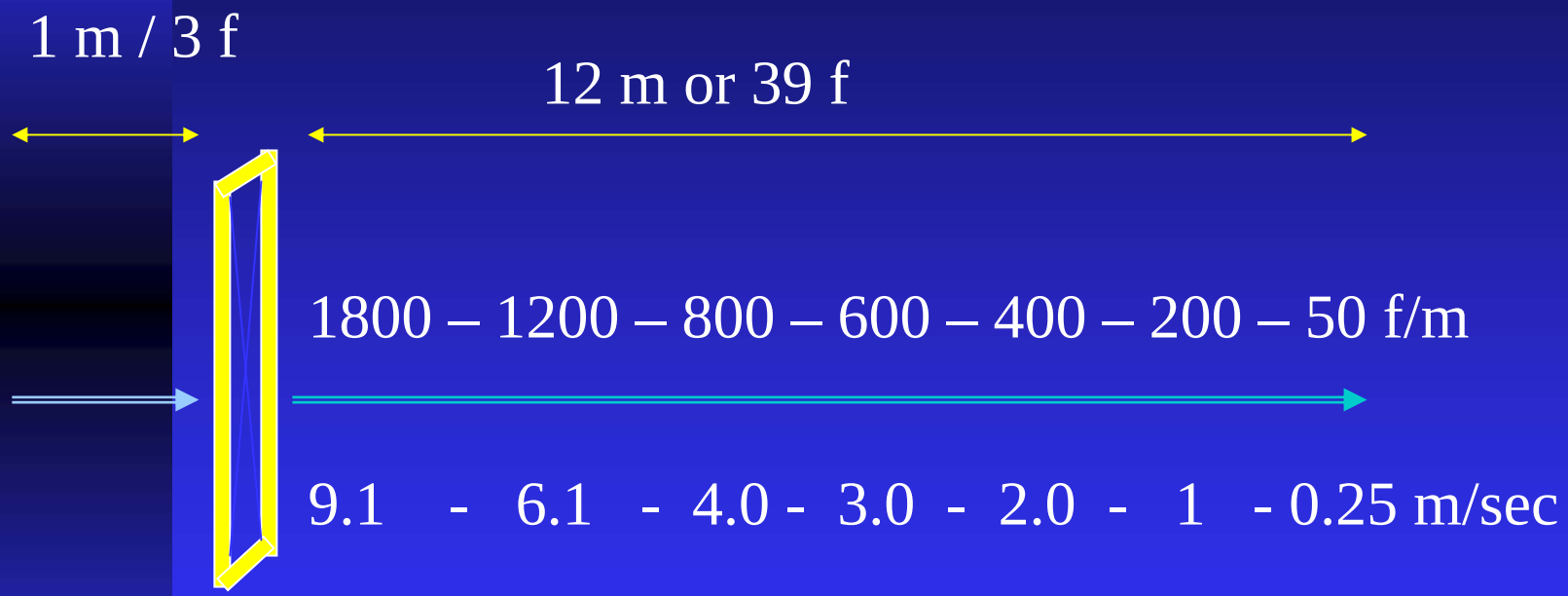
1. **NATURAL VENTILAITON** To be used when total mechanical ventilation is not available however should include minimum ventilation fans for early age.

2. **MINIMUM VENTILATION SYSTEM** To be used for cool weather and during brooding. Low air velocity over the birds and long air exchange rate. This system is for air quality and a slight amount of temperature control.

3. **TRANSITION VENTILATION SYSTEM** To be used to allow for a much better air exchange rate inside the house, without high air velocity across the birds, until the birds more than 28 days of age. Difficult to justify the cost compared to benefits.

4. **SUMMER VENTILATION SYSTEM** To be used for temperature control and create a high air speed (velocity) across the birds. To lower the effective temperature and reduce heat prostration.

What happens to Air Speed from a fan within the House



Loose hanging fan in the house

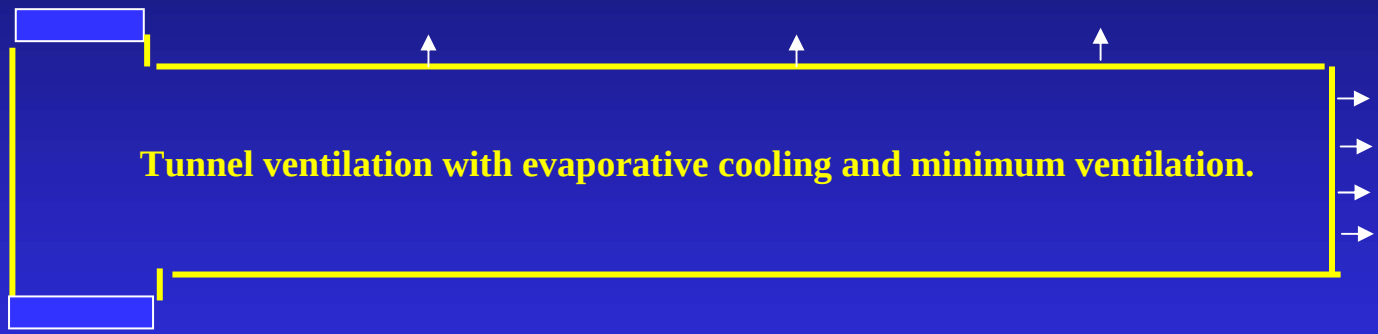
Very un -uniform air speed and migration of the birds occurs. Birds try to find the best environment.

Order of Best Ventilation Efficiencies of Chicken Houses

***All Houses Shown Have Minimum Ventilation Going Across The house.**

1-2

2-1



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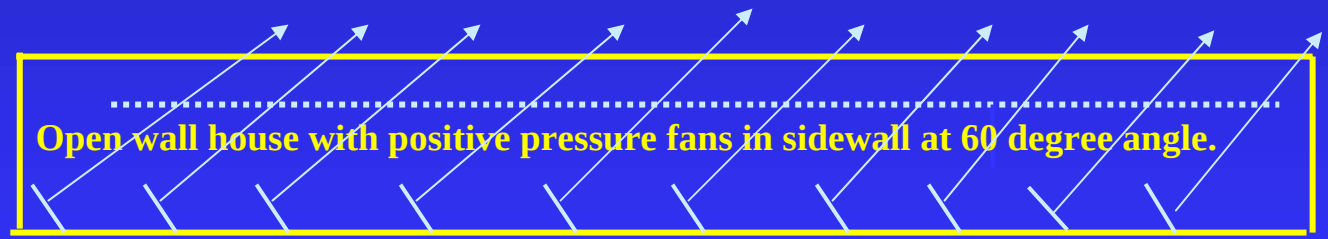

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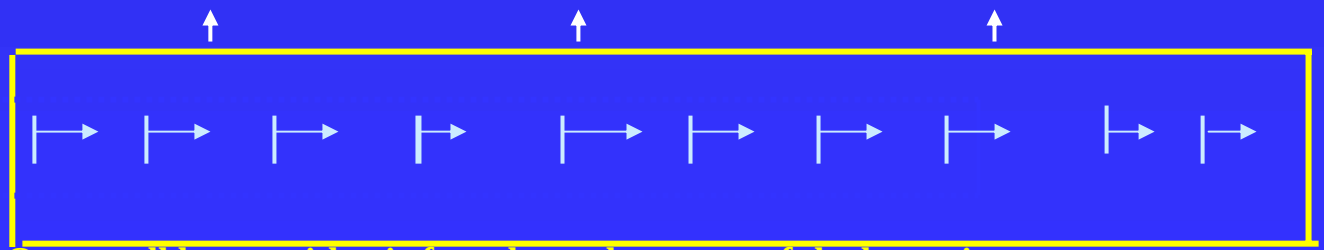
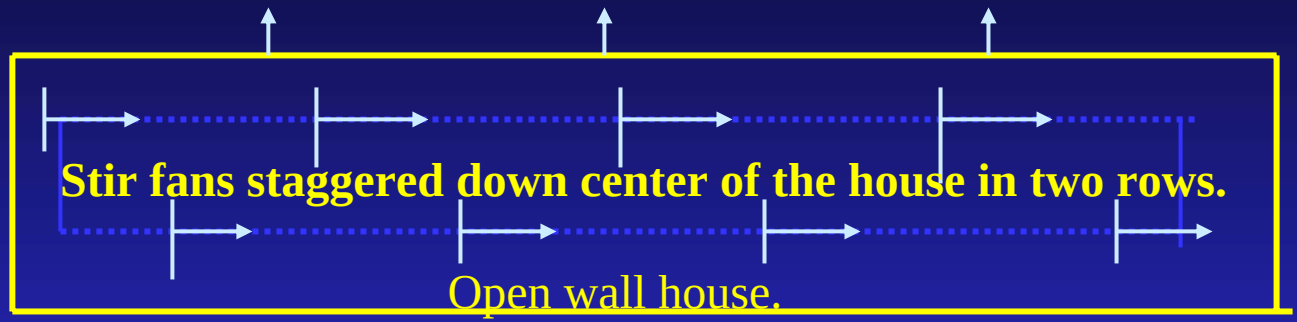


Ventilation efficiencies continue.

5



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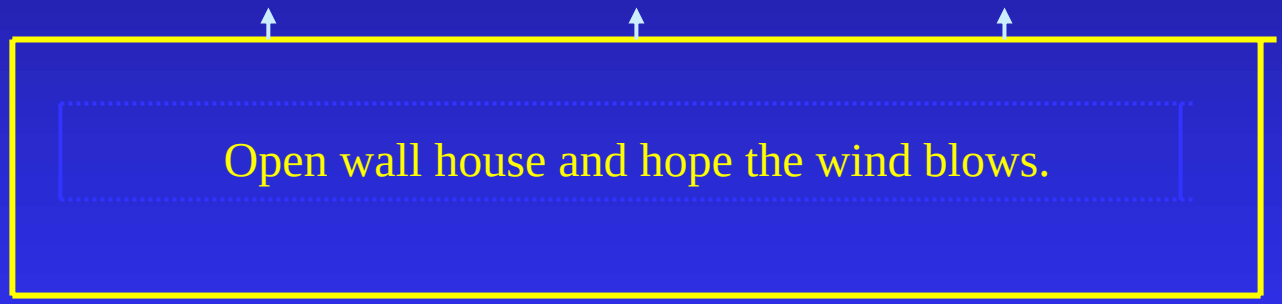
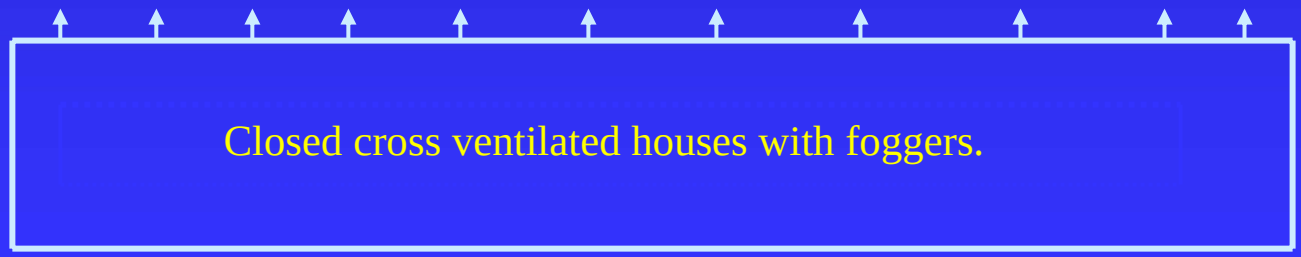


3

In mild climates

4

In hot climates




Fan model number to look for in the fan specification book
The cone fans should be installed a minimum of 1/2 the diameter of the fan from the ground and when possible 30 inches (76 cm).

Minimum Ventilation

- Is based on negative pressure in the house to get the proper air distribution.
- Is used as a cross ventilation to keep the air speed very low or almost nil in the first 2 weeks.
- Is used to avoid chilling the chicks so that all available feed energy can go for growth and uniformity.

Broiler House Ventilation System

- **HOUSES IN HOT CLIMATES CAN HAVE ONE VENTILATION SYSTEM, BUT……..**

- During the first 3 weeks the curtains are down and only natural ventilation is used.
- As of 21-28 days TUNNEL VENTILATION is used till the end to keep the birds cool and avoid heat prostration.
- However apply minimum ventilation concept if no optimal results are obtained with Natural Ventilation in the first 3 weeks, with negative reflection on final BW, Mortality and FCR (90% of the cases).

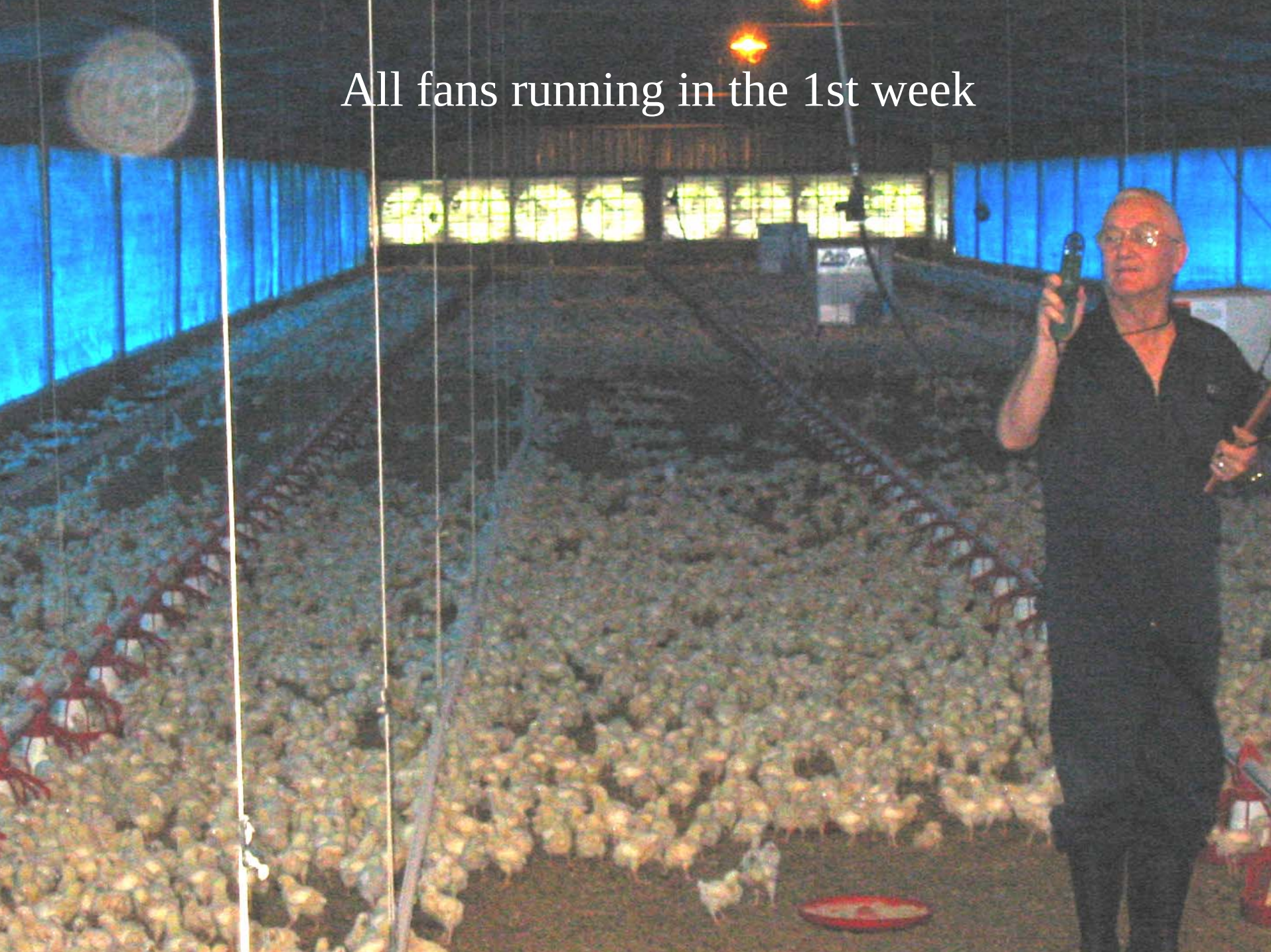
What is the Importance of Minimum Ventilation in Chicks?

- Minimum ventilation will guarantee that ventilation and fresh air are given to the chicks as of day old to obtain maximum growth rate and organ development in the first few weeks, critical for good end performance of the flock.

Air temperature & Air Speed

over the Chicks

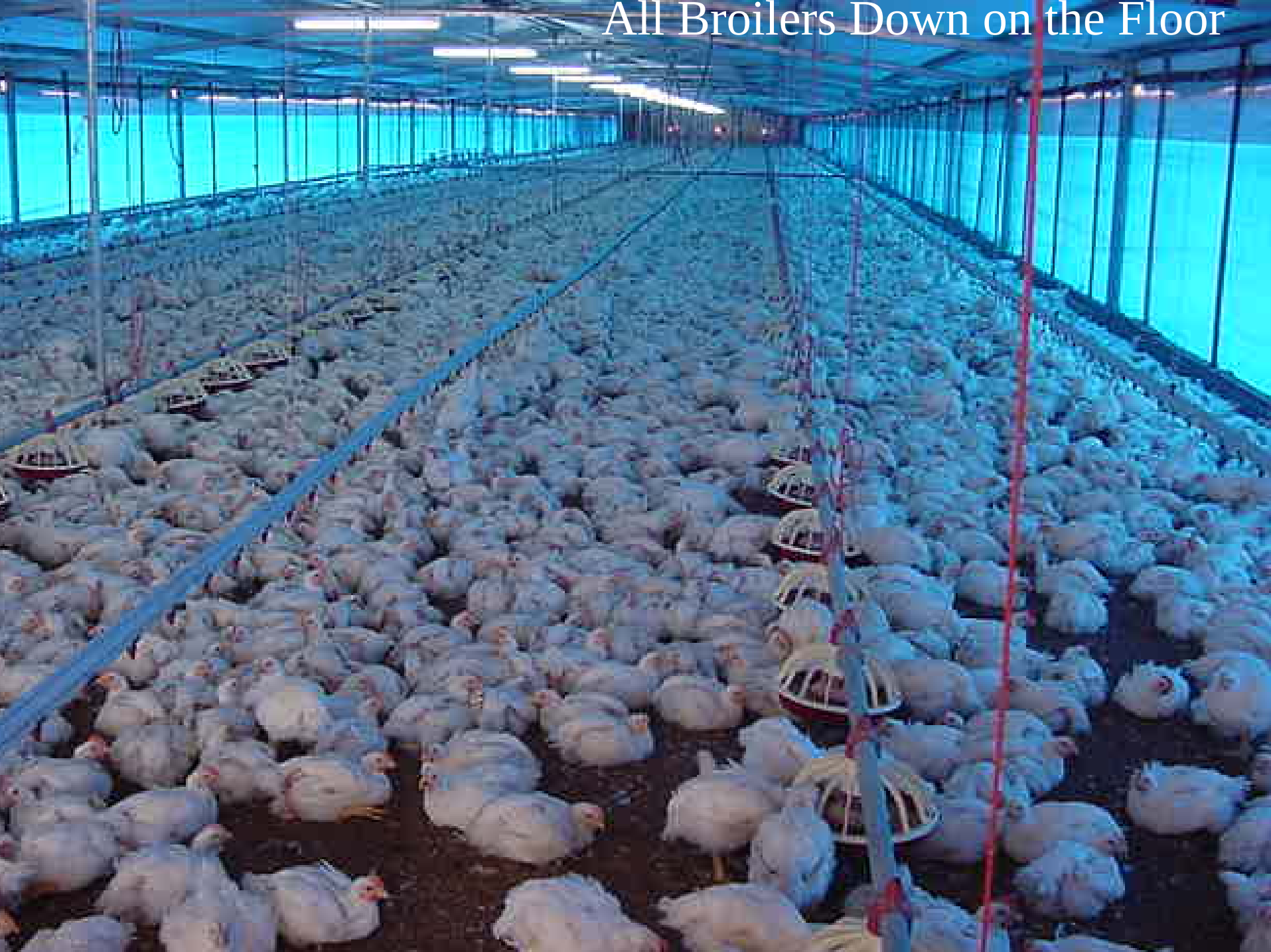
- 1st week - Still air - Max. 15 fpm.Temp. 32 ºC (90 ºF)
- 2d week - Still air - Max. 30 fpm. Temp. 29 ºC (84 ºF)
- 3d week - Max. 100 fpm. **Effective** Temp. 27 ºC (81ºF)
- 4th week - Max. 200 fpm **Effective** Temp. 25 ºC (77 ºF)
- > 28 days depending on temperature. **Effective** Temp. 22 ºC (72 ºF) and lowering to 18 ºC (64 ºF) > 35 days.


All fans running in the 1st week

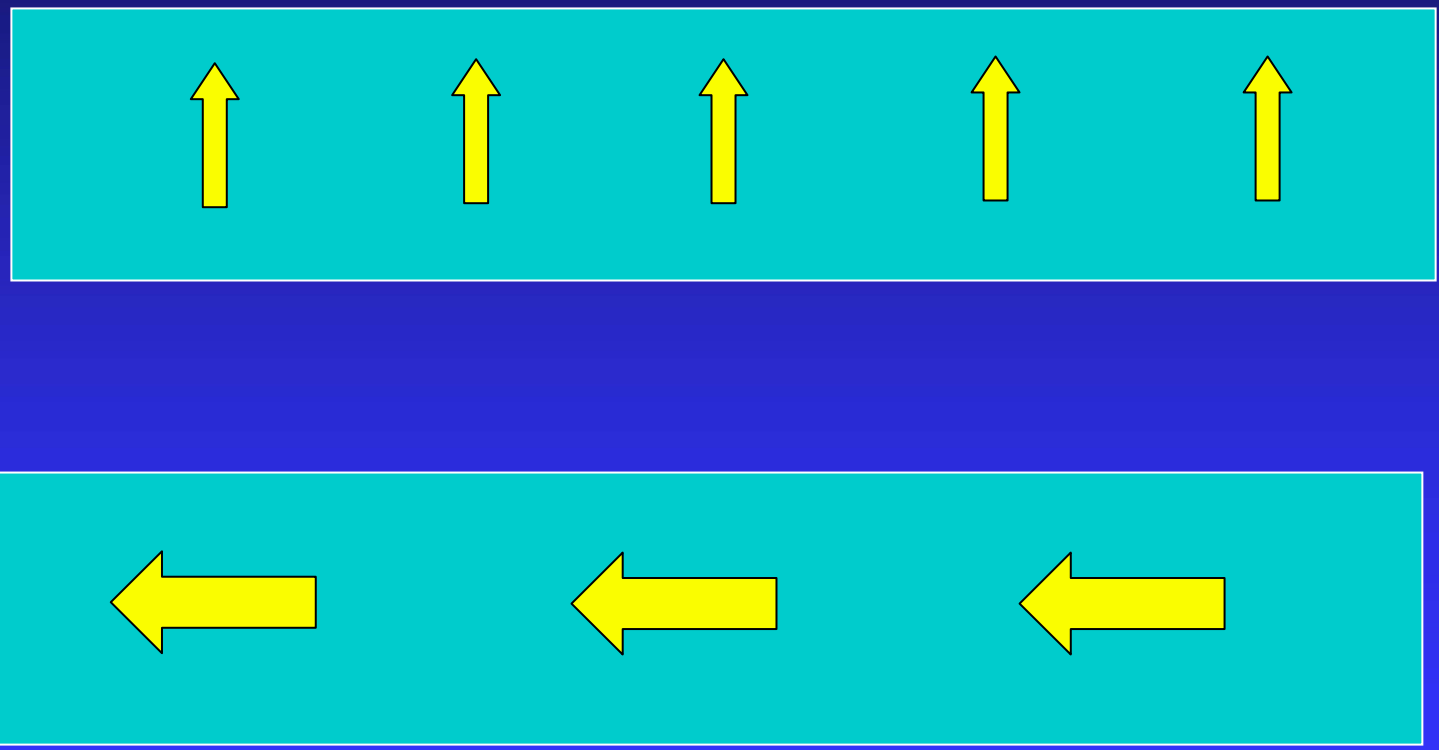

550 fpm at 25 days of age


26 Day old
Male broiler

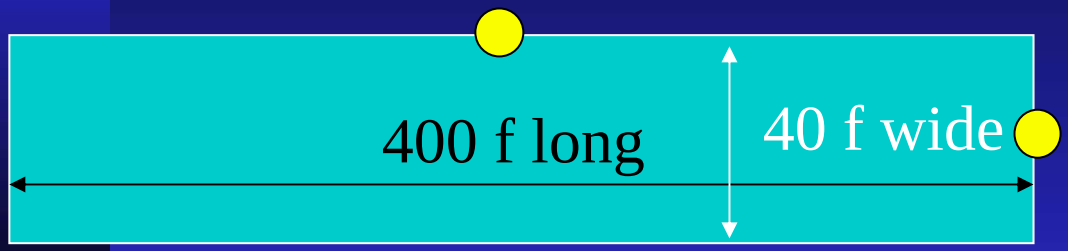
All Broilers Down on the Floor

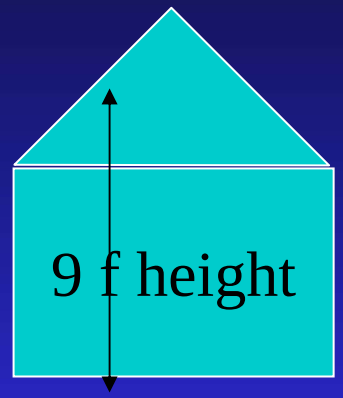


Cross and Tunnel Ventilation



Cross & Tunnel Ventilation Calculations



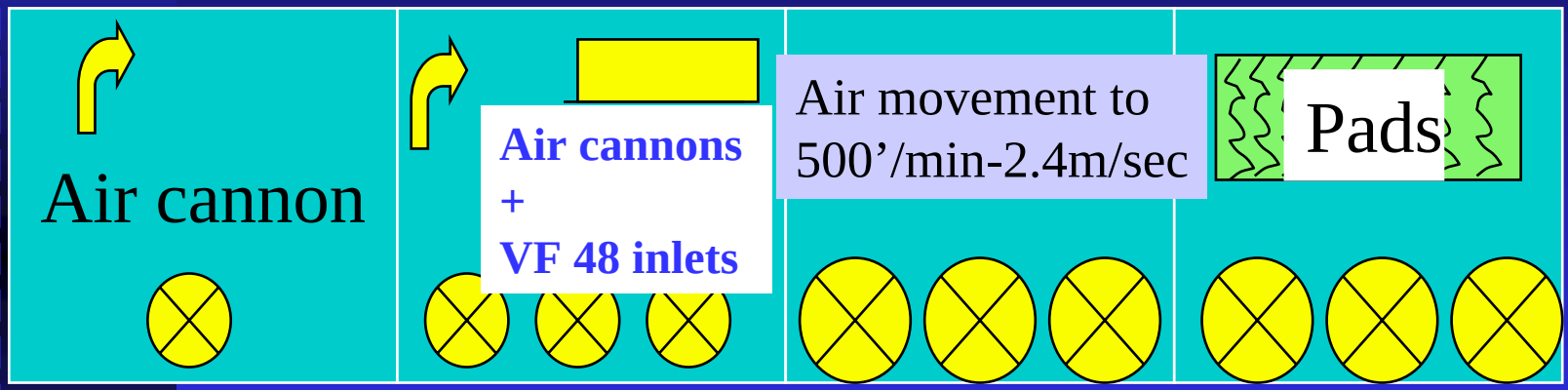


Cross ventilation: Length house x Av. Height = cross section
400 f x 9 f = 3600 f^2. 1 fan 36” = 11,000 cfm ÷ 3600 f^2 = 3 f/m

Tunnel ventilation: Width house x Av. Height = cross section
40 f x 9 f = 360 f^2. 1 fan 36” = 11,000 cfm ÷ 360 f^2 = 30 f/m
With 48” fan the air speed will increase to 21,500 cfm ÷ 360 f^2 = 60 f/m. If larger fans are used the problem only gets worse.

Explaining Ventilation Concept

Minimum Ventilation (winter) Maximum Ventilation (summer)



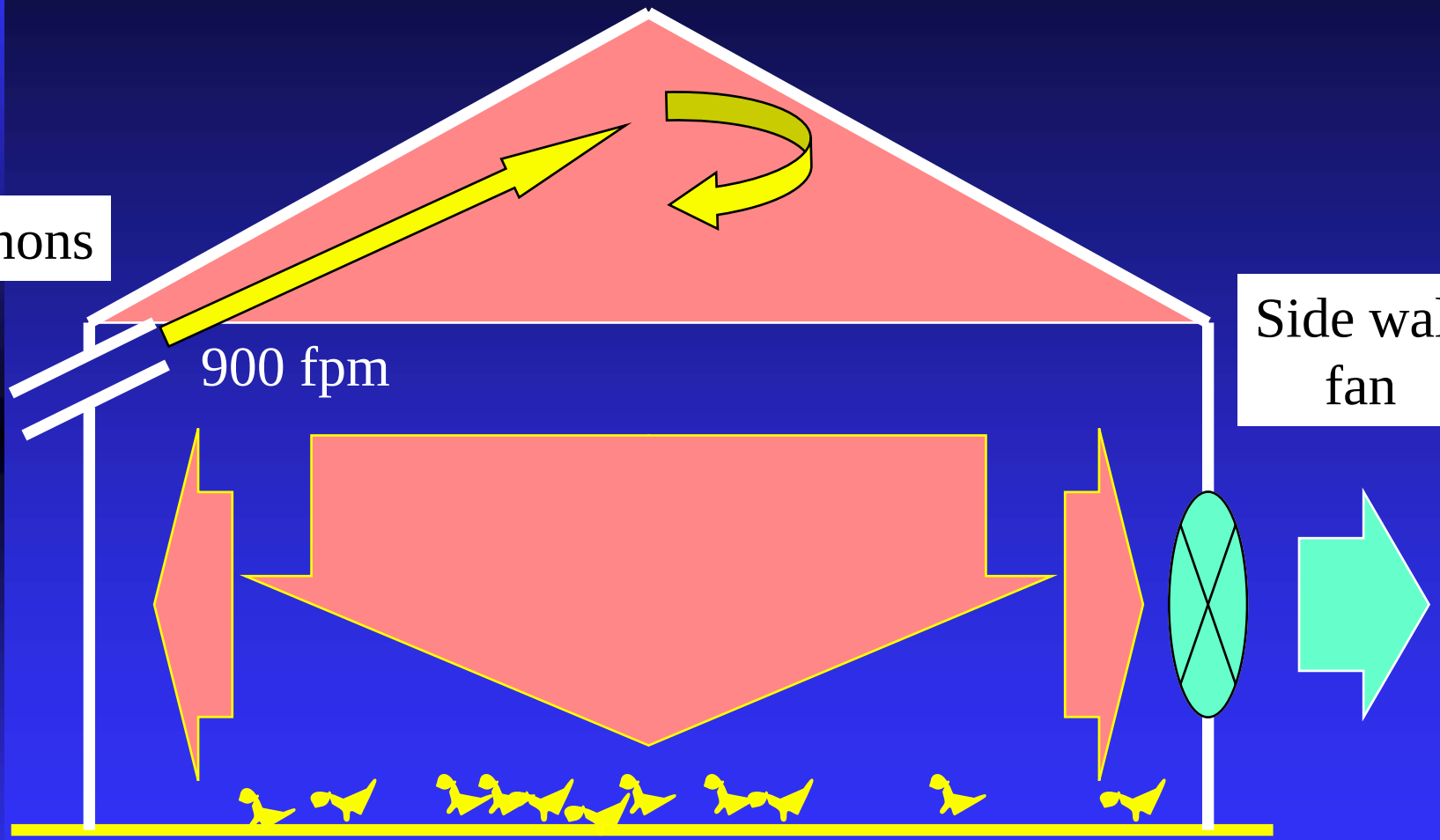
Timer controlled

Thermostat controlled

Change from min. to max. Ventilation is automatic

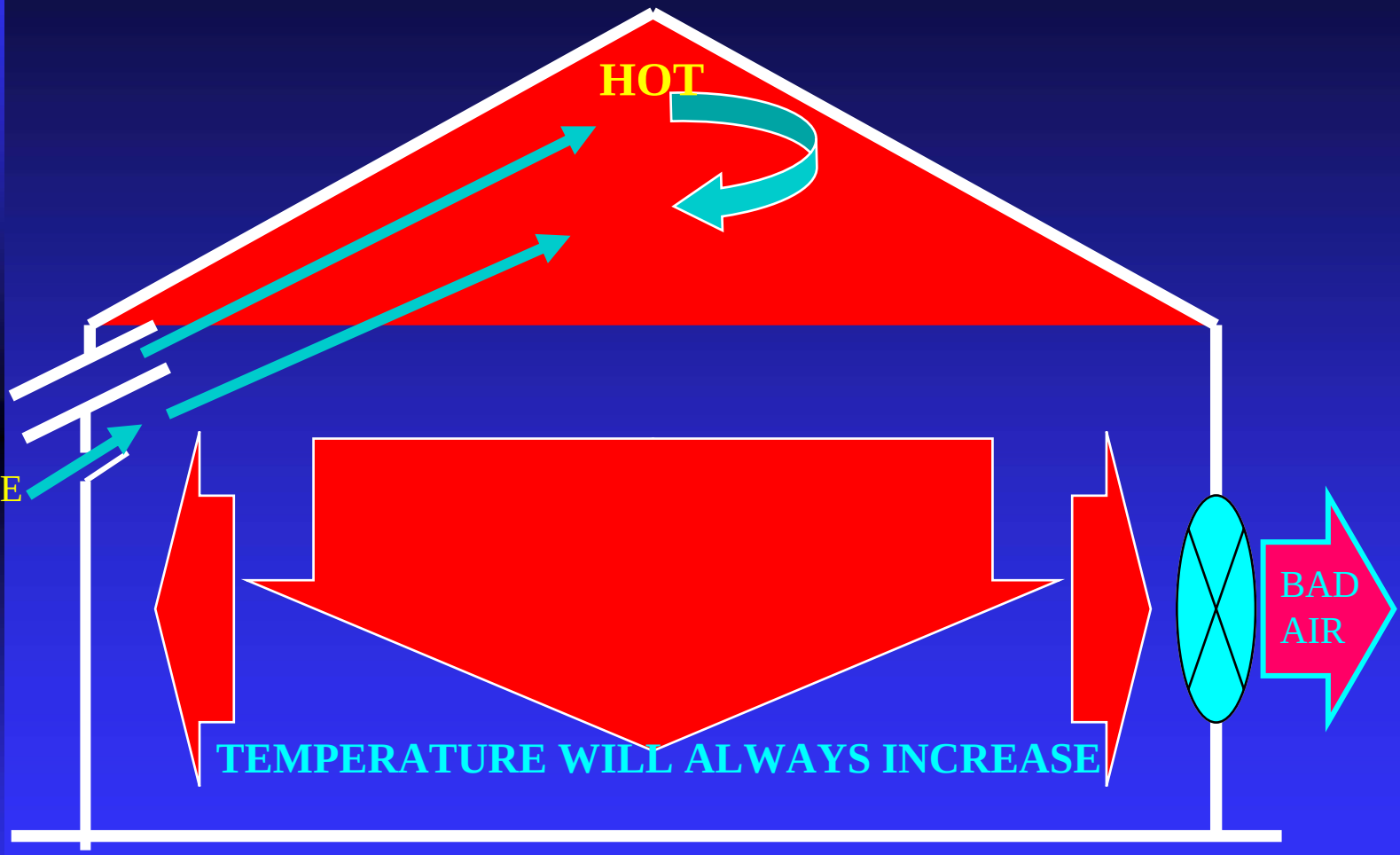
<20ºC | >20ºC | > 25ºC | > 28ºC

Cross-flow Ventilation for ALL Climates



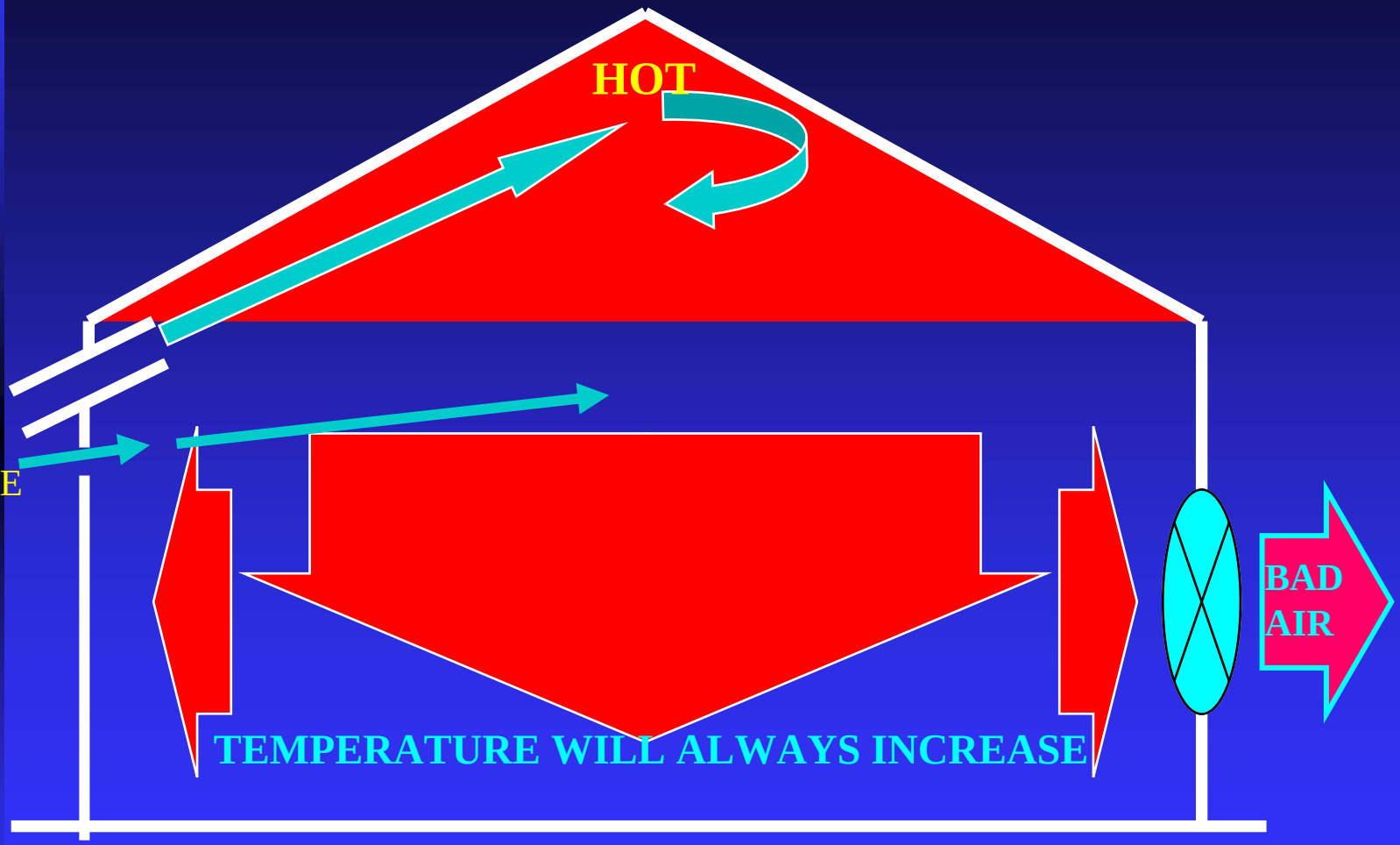
Minimum ventilation for chicks.

Cross-Flow Ventilation With Counter Balanced Inlet For Second Stage Air Volume



COMFORTABLE ANIMALS, WARM DRY FLOORS, EVEN DISTRIBUTION OF AIR, AND LOW UTILITY COSTS

Cross-Flow Ventilation With Continuous Slot For Second Stage Air Volume



COMFORTABLE ANIMALS, WARM DRY FLOORS, EVEN DISTRIBUTION OF AIR, LOW ENERGY COST

Ventilation Criteria in Sequence of Importance before 28 days of age

- Air exchange in the house. Air volume can never be compromised for temperature only.
- Pressure drop across the inlets or air cannons. Needed as an effective tool for proper air distribution and reduce heating costs.
- Air distribution. Minimum ventilation has as a rule the objective to get good warm and fresh air distribution to chicks without cooling them down.
- House temperature. Expansion of air by heat and evaporation of moisture from the air are the only two things that will keep floors dry in cold weather.

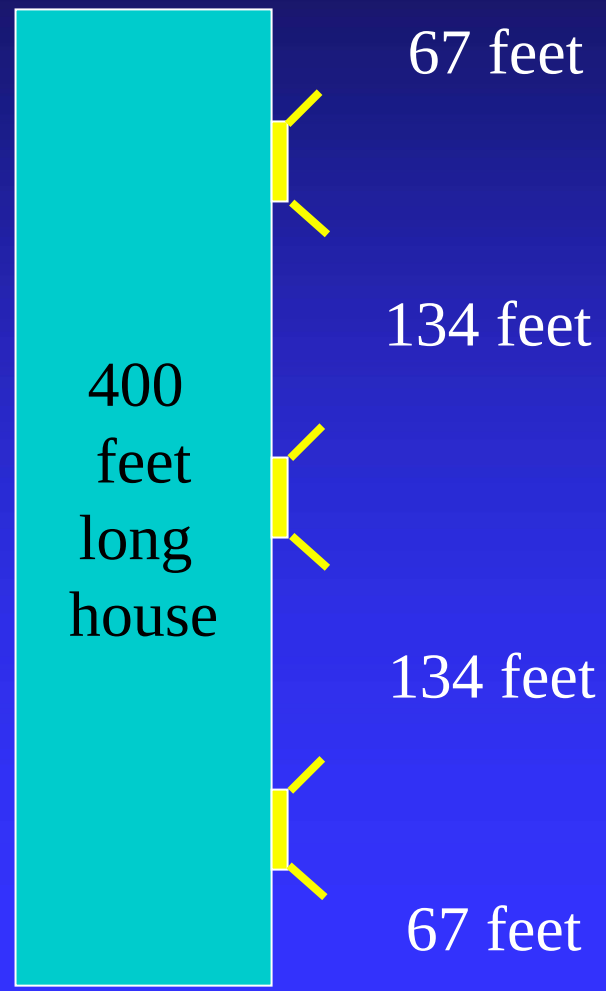
Side Fans Needed - Calculations

- Rule: Side fans runs 1 minute of every 8 minutes and then 1 minute every 5 minutes.
- Take volume house ÷ 8 = 19,000 cfm (example)
- One 36” fan rated 10,500 cfm
- 19,000 ÷ 10,500 = 2 fans

- House volume ÷ 5 = 30,400 cfm ÷ 10,500 = 3 fans in side wall.

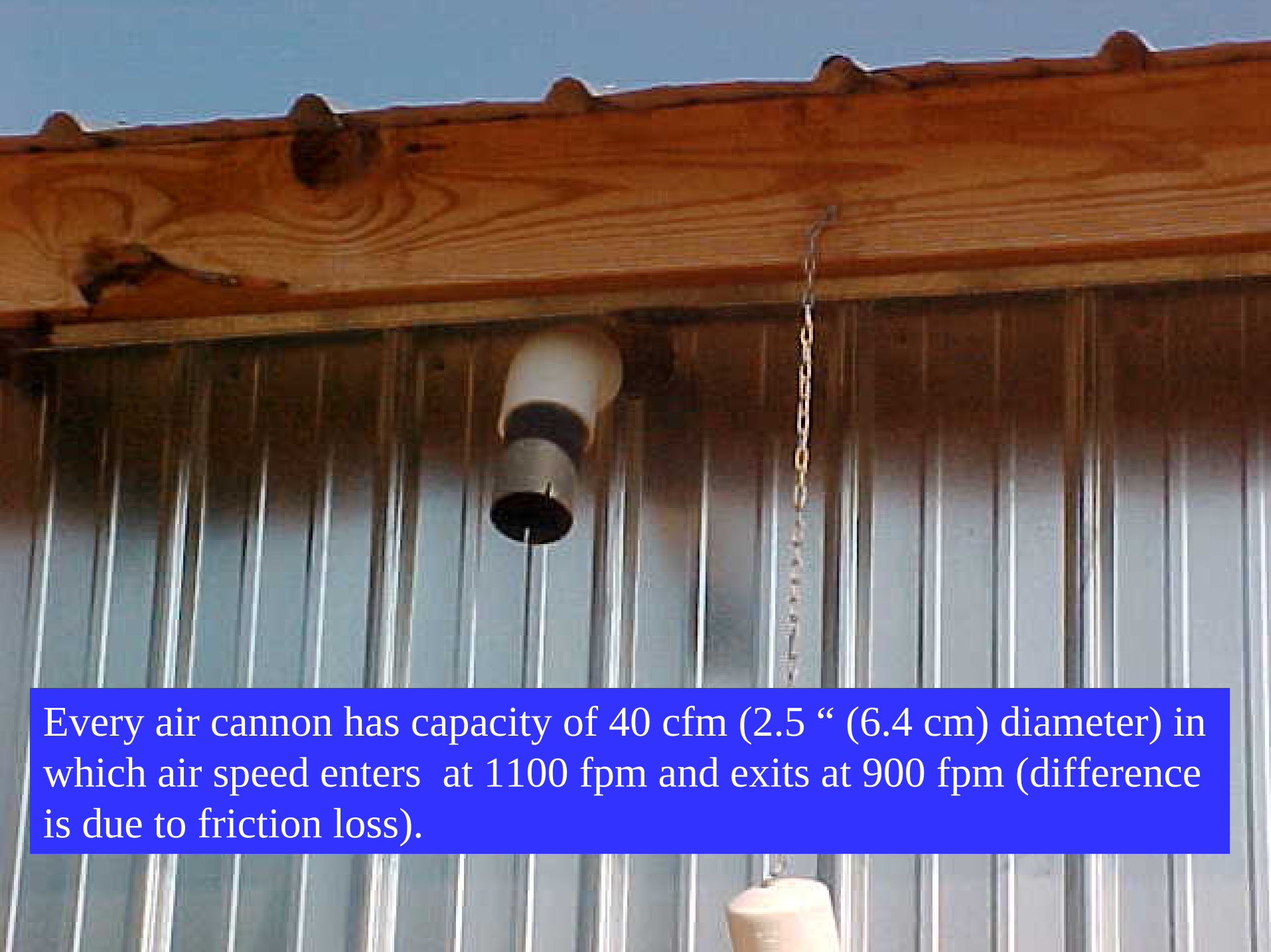
Side Fans Spacing
Calculation

- Spacing of the side fans is important.
- Take # fans and double number, so in this case 3x2=6.
- Take length house = 400 f ÷ 6 = 67 feet first fan. 2d Fan at 67 x 2 = 134 f. from first and 3d fan at same distance of 134 feet from 2d.



Air cannons-First Stage Min. Ventilation
Calculation & Spacing

- Take the length of the house ÷ 10 + 8.
- Example: 400 feet house ÷ 10 + 8 = 48 air cannons.
- In 4 corners 2 each =8
- Resting 40 to be spread out over 400 feet = 1 every 10 feet.



Every air cannon has capacity of 40 cfm (2.5 “ (6.4 cm) diameter) in which air speed enters at 1100 fpm and exits at 900 fpm (difference is due to friction loss).

Transition Ventilation

- In this procedure sufficient inlet capacity is installed so that up to 21-28 days of age the birds can have proper air exchange without the excess air speed.
- With the 2 side curtains being opened for a few cm’s or when installing inlets like TJP 2155, calculate the inlet opening based on 4 fans running instead of 2 (minimum ventilation for first 14 days).

Final Thoughts

- Minimum ventilation is very important to assure the proper growth and uniformity of the broiler flocks.
- A good start (0-14 days) represents more than 50% of the success of the flock.
- Analyze your broiler results knowing weekly BW's and mortality. With these data you should fine tune management. Minimum ventilation is a crucial part of this management.