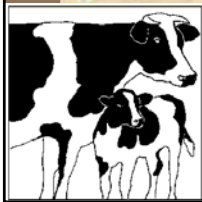


Ventilating Calf Barns in Winter

“Designing Facilities to Enhance Air Quality for the Calf”

David W. Kammel
BSE- UW-Madison



Take Home Message

- ❑ Ventilation is only one part of a complete calf housing system
- ❑ Management of the calf environment should focus on excellent air quality without draft
- ❑ A positive pressure supplemental ventilation system can improve air quality in naturally ventilated calf barns

The Options for calf housing and management are endless



Calf Management Plan

- Define the desired management groups
- Define the number of animals in each group
 - Grouping based on:
 - Comfort and environmental needs
 - Nutrition needs
 - Health needs
 - Reproductive status
 - Movement between groups
- Define the management protocols (chores)
- List Needs (and wants) of the Owner
- Determine facility features that will allow implementation of the management plan
- Prioritize the list of features

Calf Management Plan

“Needs of the calf”

- **Provide a safe, comfortable, & healthy environment**
 - Space to rest and walk
 - Clean & dry resting space
 - Avoid nose to nose contact
 - Fresh air (ventilation without a draft)
 - Adequate feed and water
 - Manage temperature extremes



Calf Hutch



Group Calf Housing



Limitations of hutch system

- ☐ Melting snow and rain wet the bedding
- ☐ Snow removal from hutch area
- ☐ Alternate housing during extreme cold
- ☐ Inclement weather working conditions
- ☐ Increased labor during inclement weather
- ☐ Inefficient labor during inclement weather

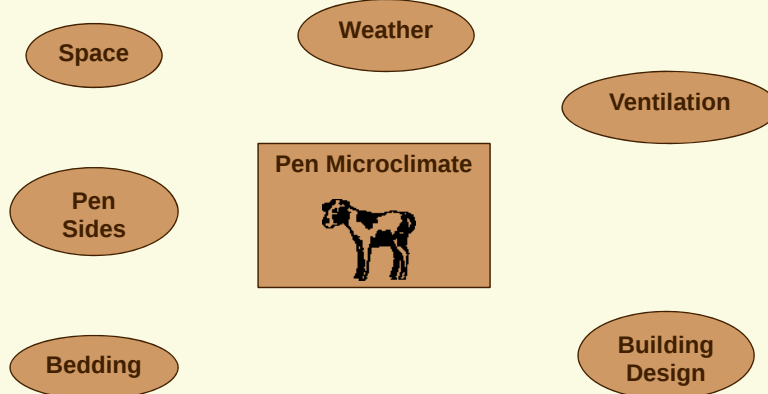
Calf Management Plan “Needs of the Owner”

- ☐ Safe & Labor efficient
 - Observation, feeding, cleaning, handling & treatment
 - Comfortable work environment
- ☐ Effectively utilize a farm’s resources
 - Capital
 - Labor
- ☐ Environmentally friendly

Calf Barn Design Challenge

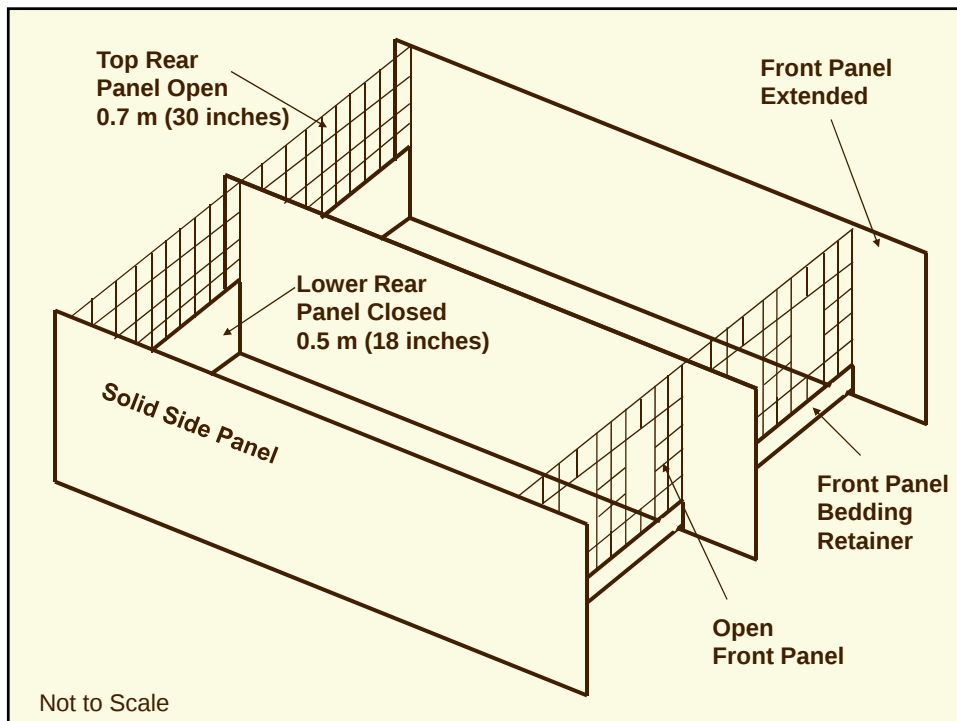
- ☐ Provide a suitable environment for the calf
- ☐ Provide a suitable environment for the caretaker

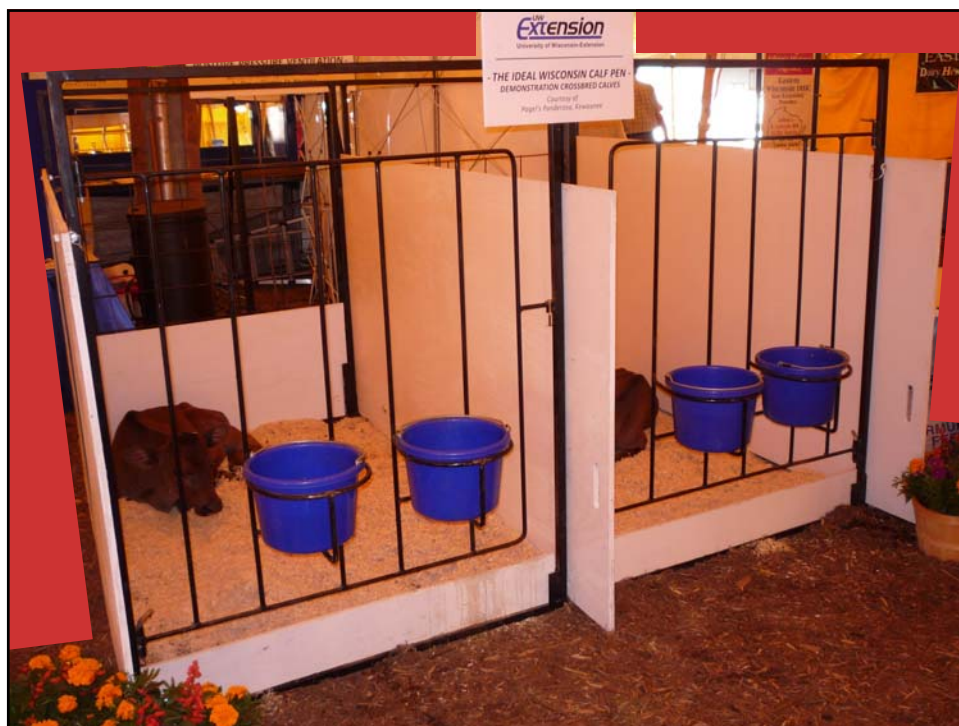
Pen Design













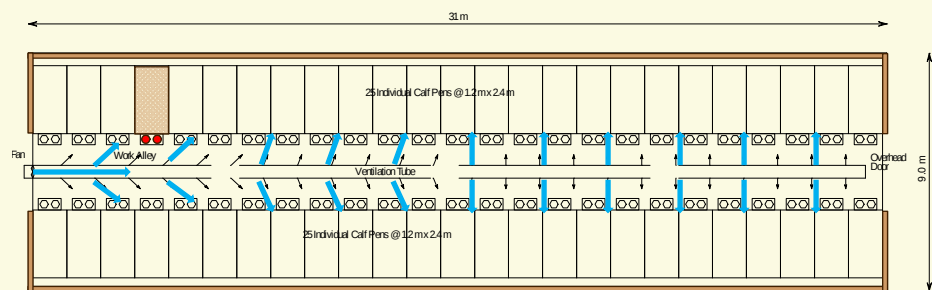


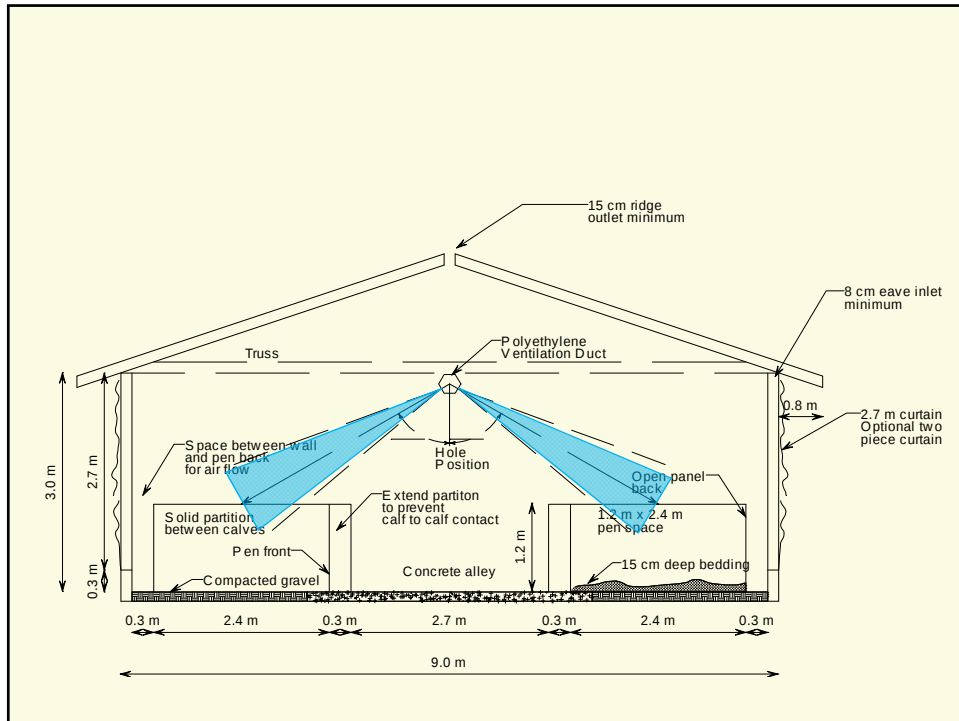


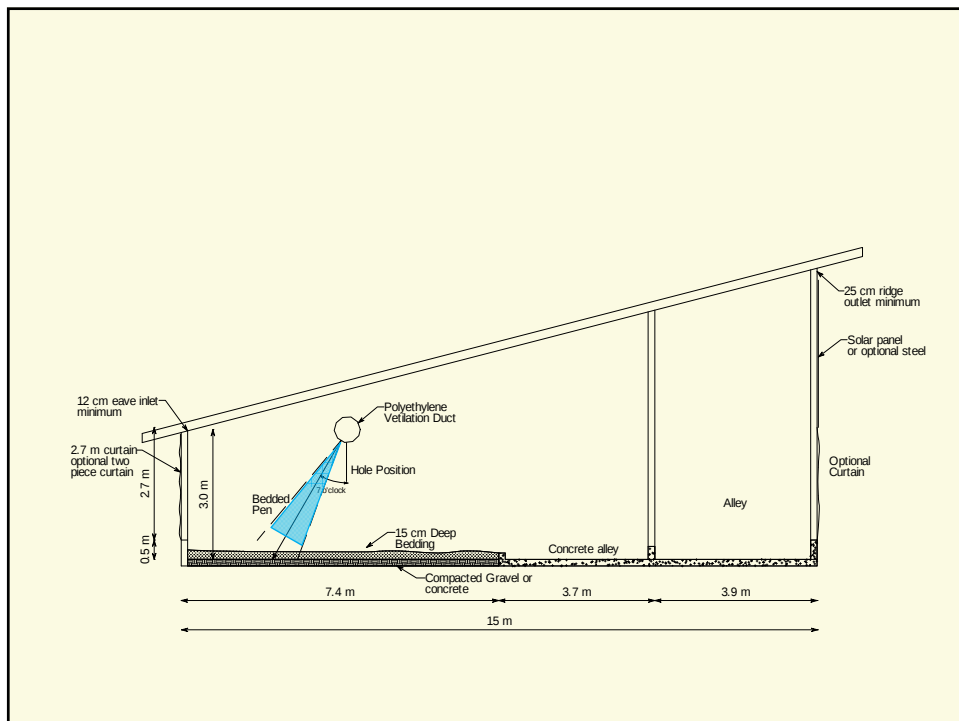
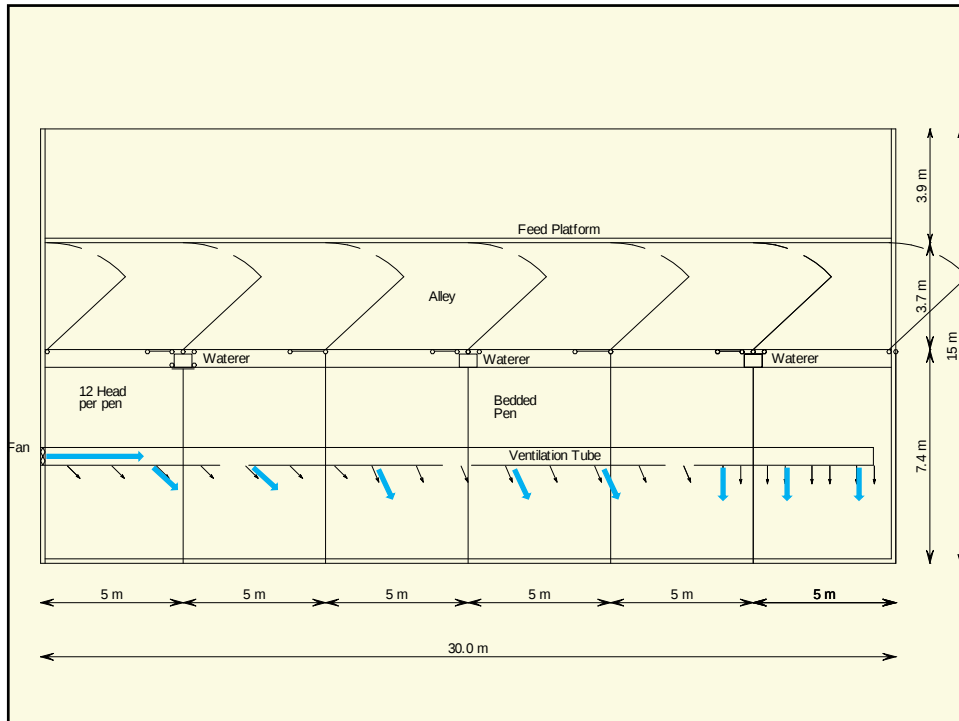


Winter Ventilation Design

- Minimal air exchange
- Positive pressure system design
- Even air distribution
- Control draft
- Temperature control ?





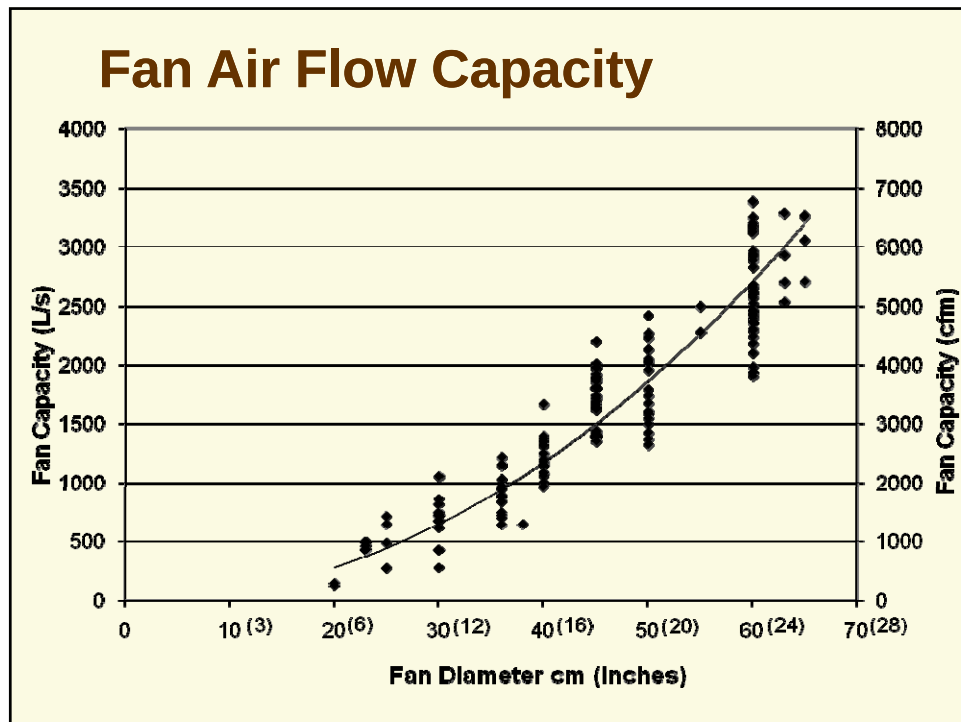


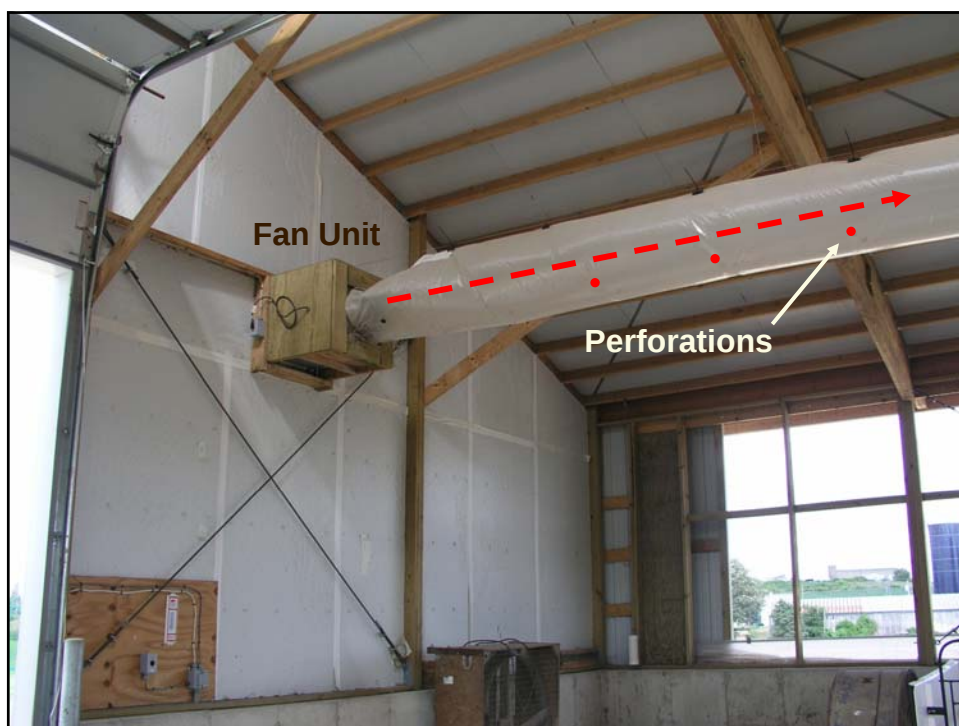


Ventilation Recommendations

Temperature	Air flow per calf	Building Air Volume Changes
Cold - 23 °C to -7 °C, (-10 °F to +20 °F)	7 l/s (15 cfm)	4 air changes per hour
Mild - 7 °C to 10 °C (+20 °F to +50 °F)	24 l/s (50 cfm)	15 air changes per hour
Warm > 10 °C (+50 °F)	56 l/s (120 cfm)	60 air changes per hour

Table 1. Ventilation recommendations for calf barns (Midwest Plan Service)





Polyethylene Duct Air Flow Capacity

Duct Diameter cm (inches)	Duct Velocity					
	2 m/s (400 fpm)		4 m/s (800 fpm)		5 m/s (1000 fpm)	
	Air flow l/s (cfm)	Number Calves	Air Flow l/s (cfm)	Number Calves	Air Flow l/s (cfm)	Number Calves
Duct Air Flow Capacity						
15 (6)	37 (79)	5	74 (157)	10	93 (196)	13
20 (8)	66 (140)	9	132 (279)	19	165 (349)	23
25 (10)	103 (218)	15	206 (436)	29	257 (545)	36
30 (12)	148 (314)	21	296 (628)	42	370 (785)	52
40 (16)	263 (559)	37	527 (1117)	74	659 (1396)	93
45 (18)	333 (707)	47	667 (1414)	94	834 (1767)	118
50 (20)	412 (873)	58	823 (1745)	116	1029 (2182)	145
60 (24)	593 (1257)	84	1186 (2513)	168	1482 (3142)	209
75 (30)	926 (1963)	131	1852 (3927)	262	2315 (4909)	327

m/s = meter per second, fpm = feet per minute, l/s = liter per second, cfm = cubic feet per minute,
Number Calves based on 7 l/s (15 cfm) per calf.



Outlet Hole Air Flow Capacity

Hole Diameter	Air Velocity		
	3 m/s (600 fpm)	4 m/s (800 fpm)	5 m/s (1000 fpm)
	Hole Air Flow Capacity		
mm (inches)	l/s (cfm)	l/s (cfm)	l/s (cfm)
12 (0.5)	0.4 (1)	0.5 (1)	0.6 (1)
25 (1.0)	1.5 (3)	2.0 (4)	2.5 (5)
38 (1.5)	3.4 (7)	4.6 (10)	5.7 (12)
50 (2.0)	6.1 (13)	8.2 (17)	10.2 (22)
63 (2.5)	9.6 (20)	12.7 (27)	15.9 (34)
75 (3.0)	13.8 (29)	18.4 (39)	22.9 (49)

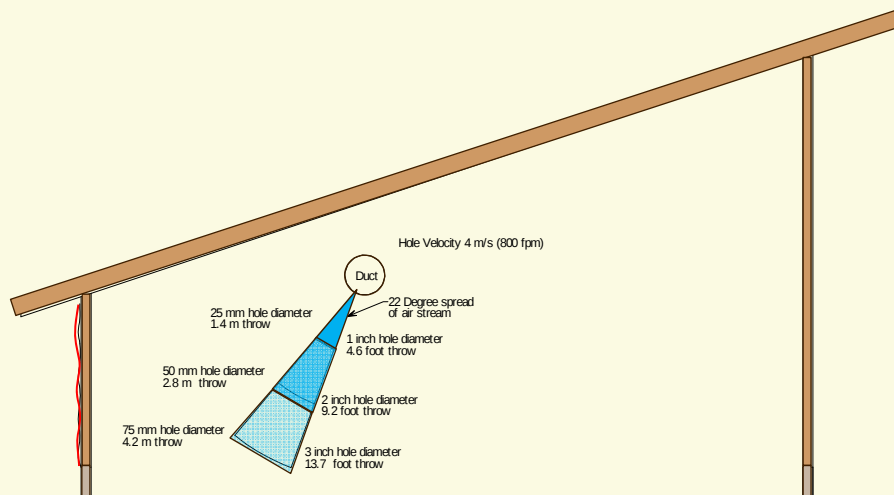
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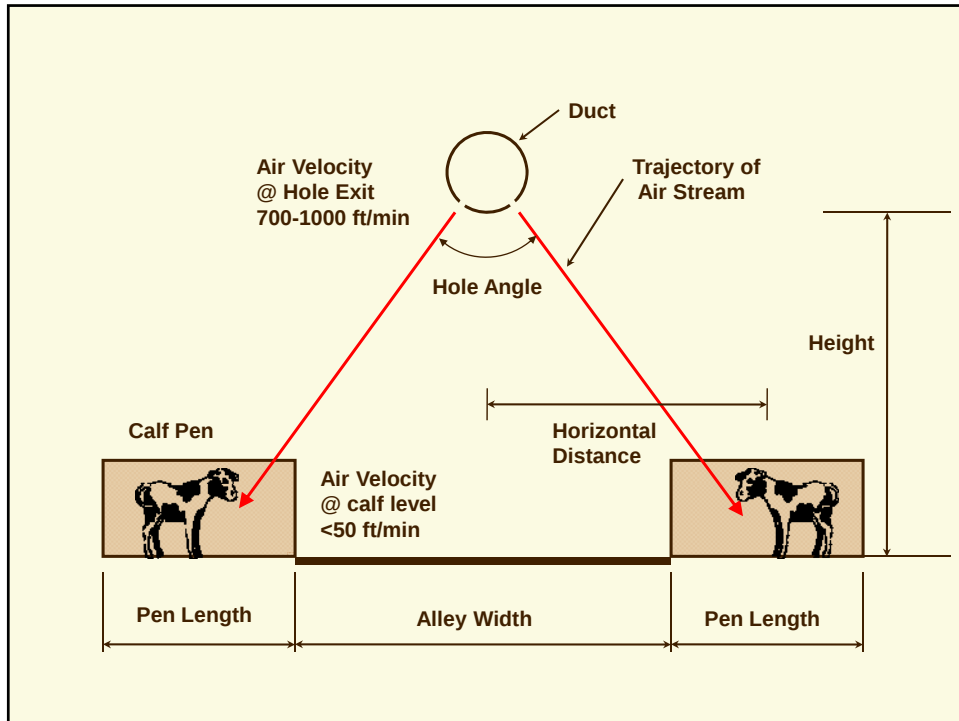
Throw Distance to still air

	Air Velocity								
	3 m/s (600 fpm)			4 m/s (800 fpm)			5 m/s (1000 fpm)		
Hole diameter	25mm 1 inch	50mm 2 inch	75mm 3 inch	25mm 1 inch	50mm 2 inch	75mm 3 inch	25mm 1 inch	50mm 2 inch	75mm 3 inch
Throw distance to still air	1.1 m 3.4 ft	2.1 m 6.9 ft	3.2 m 10.3 ft	1.4 m 4.6 ft	2.8 m 9.2 ft	4.2 m 13.7 ft	1.8 m 5.7 ft	3.5 m 11.5 ft	5.3 m 7 ft

m/s = meter per second, fpm = feet per minute

Throw Distance to still air









Technical points

- Fans mounted in wall, not inside barn
- Sized at ~15 cfm / calf
- One tube per ~25 ft of building width
- Holes sized so the air exits at ~ 800 fpm
- Holes punched at correct position depending on height of tube

Take Home Message

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