Vermont Dairy Producers Conference

South Burlington, VT

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Facilities Designed for Calf Health

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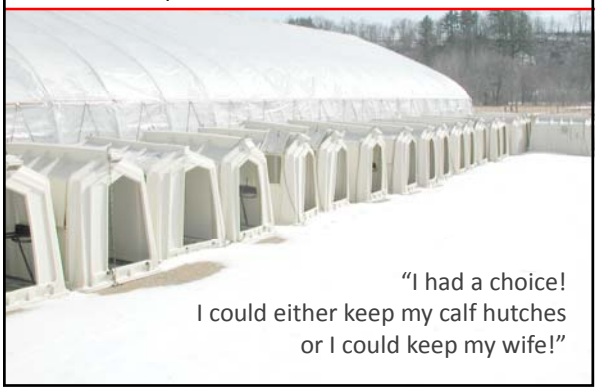
So what's the problem with hutches?

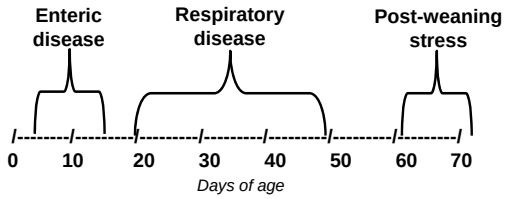


"I had a choice!
I could either keep my calf hutches
or I could keep my wife!"

Why calf barns?

- "The weather outside is frightful!'
  Christmas carol by Jule Styne, "Let It Snow"
- Impact of growth rate during 1st 60 days on adult milk yield (rates difficult to achieve in winter in hutches)
  Soberon et al, J. Dairy Sci., 2012
- Automatic calf feeders not feasible in hutches
- Naturally ventilated barns with high-quality supplemental tube systems are providing health results equivalent to hutches

Primary risk periods for calves



What can we do with housing to minimize these risks?

Key issues in healthy calf housing

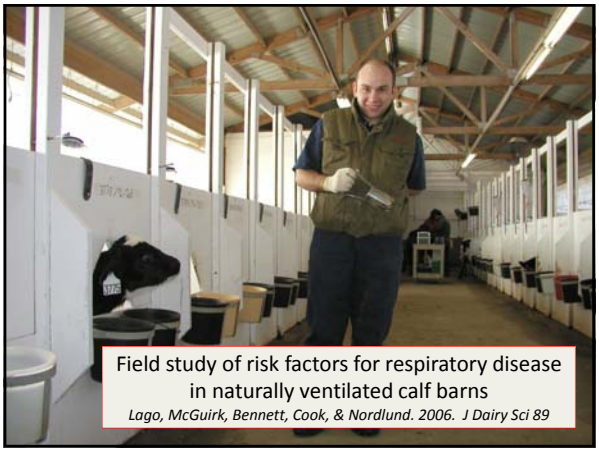
- Use drainage to reduce spread of diarrhea-causing organisms
- Introduce fresh clean air into the micro-environment around the calf
- Avoid cold-stress when temperatures drop into 40°F's and lower
- Minimize exposure of naive young calves to older pathogen-shedding calves
- Reduce social stress at weaning

Topics

- Field study of calf barn respiratory disease risk factors
- Limitations of natural ventilation
- Features of "New Generation" tubes
- Comments on drainage and calf groupings/social stress
- Some example barns

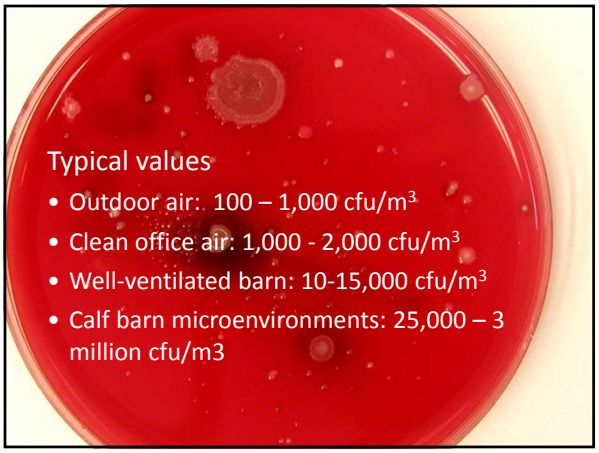
Naturally ventilated calf barns

Individual pens
Solid or mesh sides
Pen covers?
Variable bedding
Respiratory disease



Field study of risk factors for respiratory disease in naturally ventilated calf barns
Lago, McGuirk, Bennett, Cook, & Nordlund. 2006. J Dairy Sci 89

Impaction-type air sampling device



Typical values
- Outdoor air: 100 – 1,000 cfu/m^3
- Clean office air: 1,000 - 2,000 cfu/m^3
- Well-ventilated barn: 10-15,000 cfu/m^3
- Calf barn microenvironments: 25,000 – 3 million cfu/m3

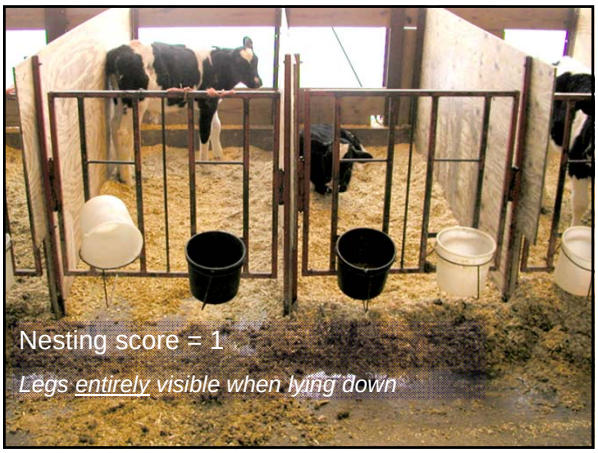
Finding:
Total airborne bacterial cfu/m^3 in PEN associated with prevalence of respiratory disease $P \leq 0.003$
Association is not causation…

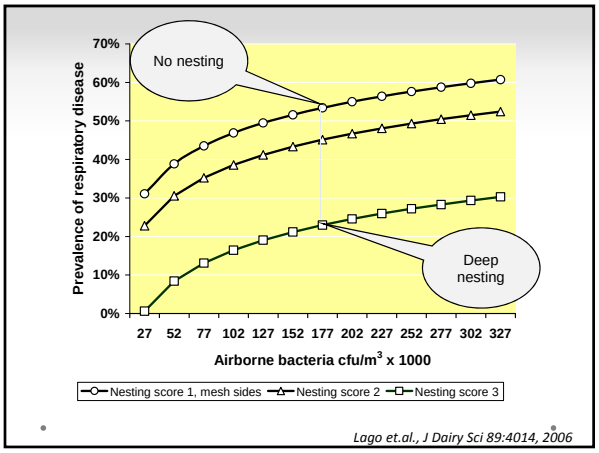
Lago et.al., J Dairy Sci 89:4014, 2006

Key factors for respiratory health

1) Low pen airborne bacteria counts
   P<0.003
   - *Total bacterial counts significant*
   - *Coliforms (EMB) not significant*
2) Nesting in deep bedding *P<0.002*
3) Solid panel between calves *P<0.003*

Lago et.al., J Dairy Sci 89:4014, 2006





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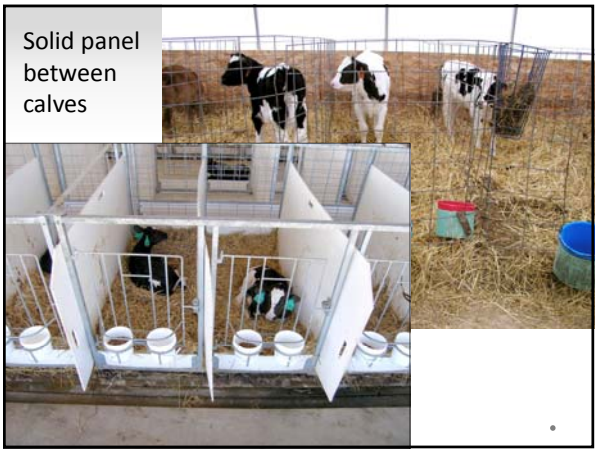
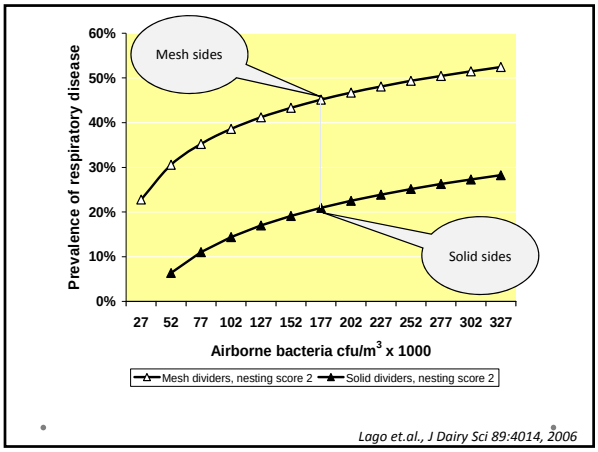
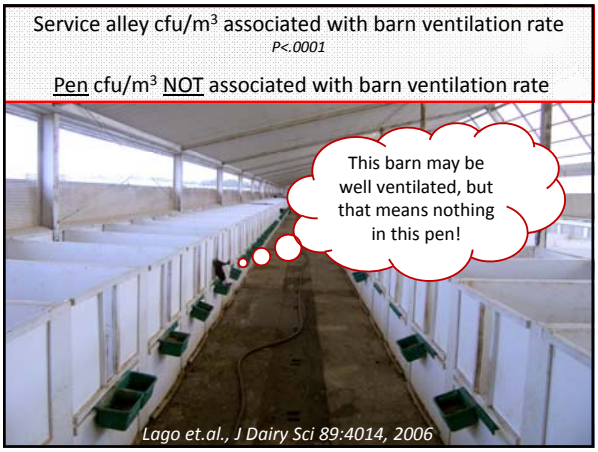
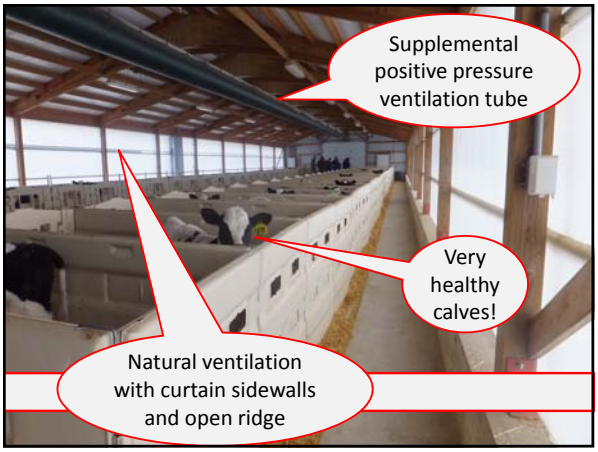






Topics

- Field study of calf barn respiratory disease risk factors
- Limitations of natural ventilation
- Features of "New Generation" tubes
- Comments on drainage and calf groupings/social stress
- Some example barns



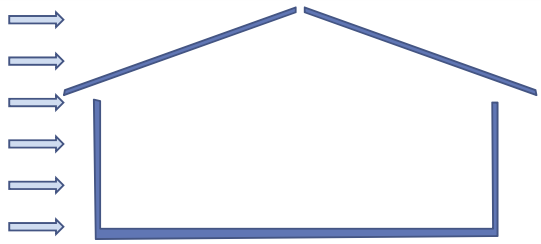
Why supplement natural ventilation?

- We estimate several thousand calf barns in North America have been fitted with positive pressure tubes during past 5 years. Why?
- The adoption driven by dairy farmer testimonials leading to demand by others
- Typical comment is that they will reduce calf pneumonia treatments by ½ to ¾
- Widespread adoption suggests that "natural" ventilation insufficient for optimal calf health

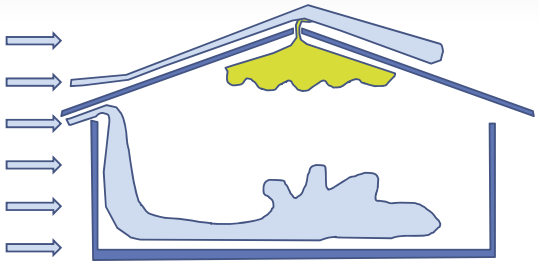
A Primer in Natural Ventilation

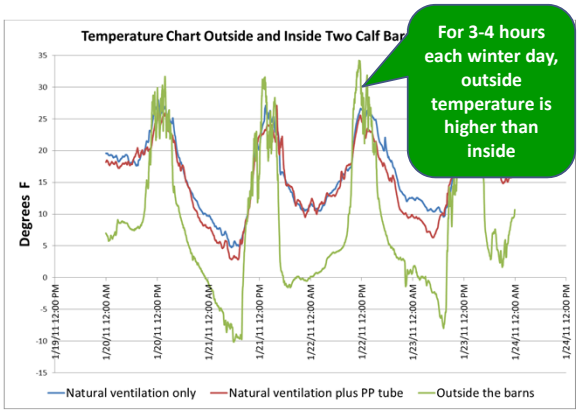
- Prevailing winds
  - Move directly into eave (and sidewall) openings
  - Travel over an open ridge and create a negative pressure or "lift'
- Thermal buoyancy as animals heat surrounding air, which causes it to rise out ridge opening

Natural ventilation by wind

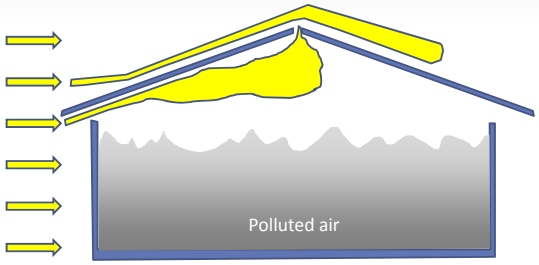


Outside air colder than inside

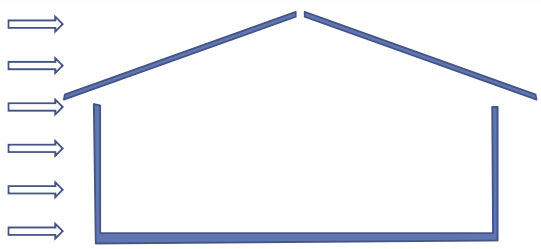




Outside air warmer than inside



Wind becomes still

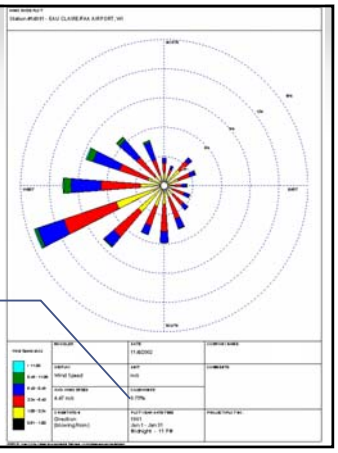


Wind rose:

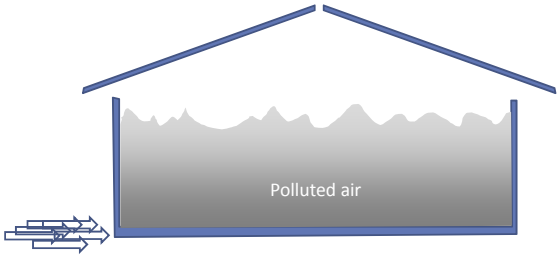
Wind in Eau Claire, WI in January

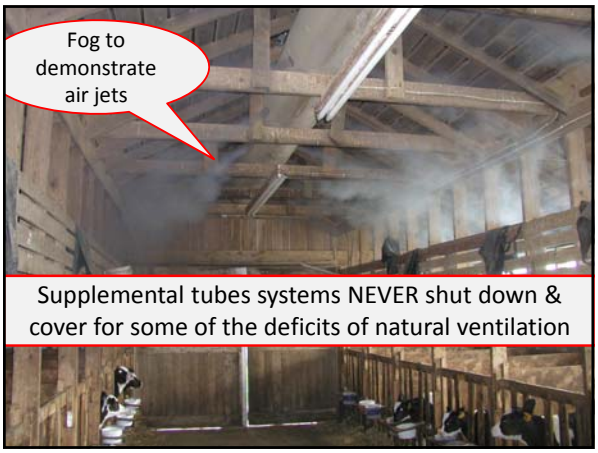
"Calm" 10% of time

http://www.wcc.nrcs.usda.gov/ftpref/downloads/climate/windrose/



"Still" winds





Supplemental tubes systems NEVER shut down & cover for some of the deficits of natural ventilation

Topics

Field study of calf barn respiratory disease risk factors

↘

Limitations of natural ventilation

Features of "New Generation" tubes

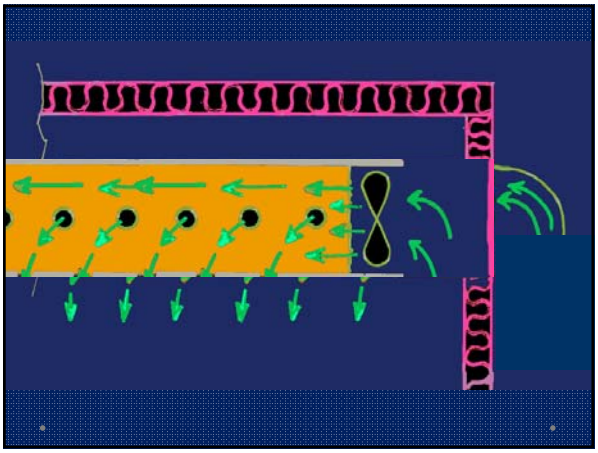
Comments on drainage and calf groupings/social stress

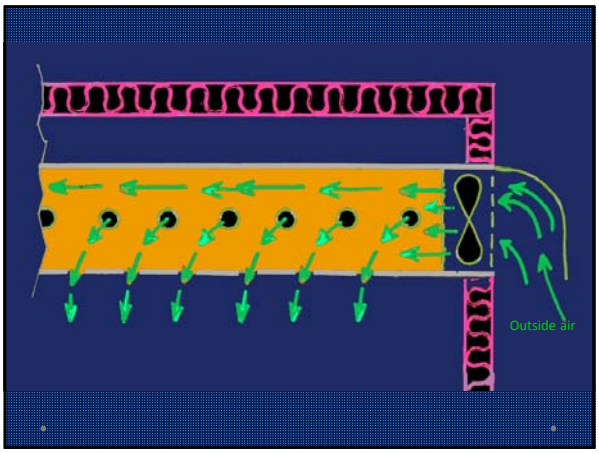
Some example barns

"New Generation" Tubes

- Not the tubes of the 1980's!
- Supplemental to natural ventilation, not recirculation
- Non-stop and deal with cold through ample bedding, etc.
- Technical differences in tube design
  - Uniform discharge along the length
  - "Throw" distance to avoid drafts

This is NOT what we are talking about!



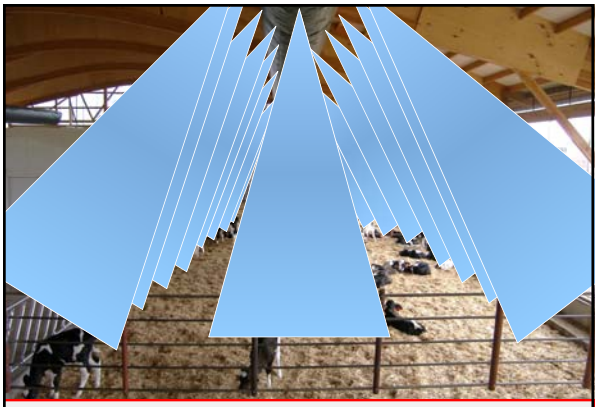


Designing the systems

- Size the fan(s) to change the air in the barn ~4 times per hour
- Appropriate diameter of the tube to assure uniform discharge along the length of the tube
- Size and number of discharge holes to deliver air to calf without a draft

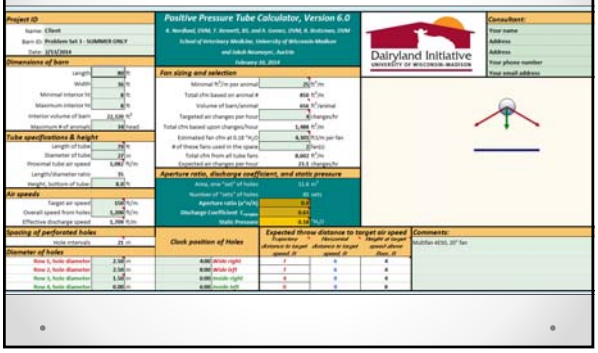
Tubes require “custom” fitting

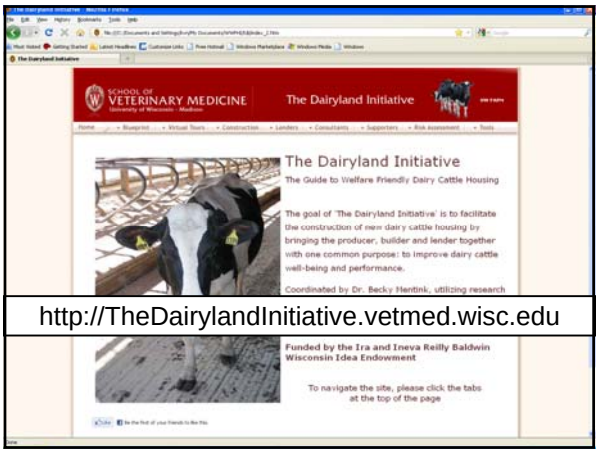
- Diameter of tube and sum of discharge hole area MUST be appropriate for capacity of fan
- Height of tube affects required “throw” distance, i.e., lower tube requires more and smaller discharge holes
- Width of coverage area affects the needed “throw” distance, i.e., clock position and sizing of holes



Group pen, automatic feeder calf barns

PPTC 6.0 Spreadsheet





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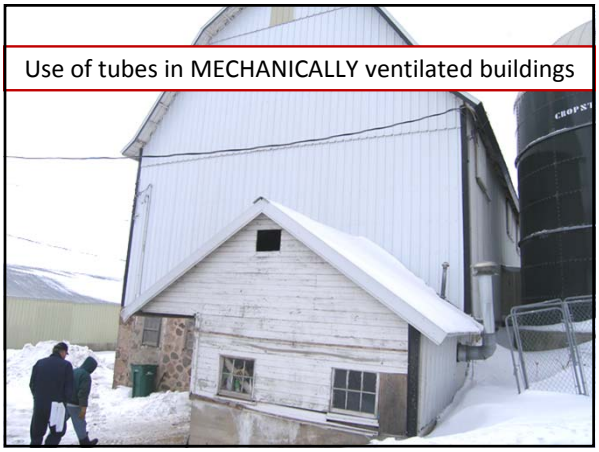
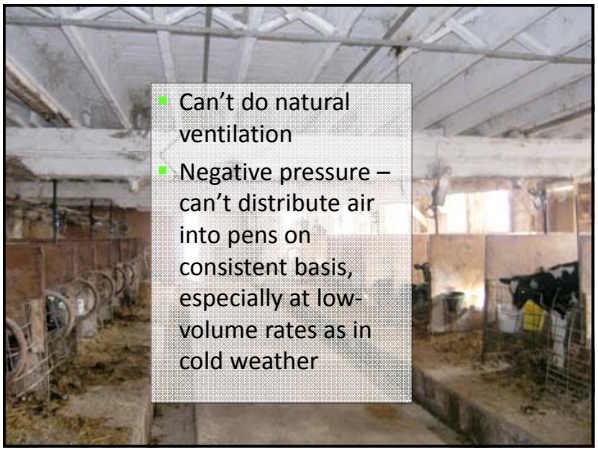
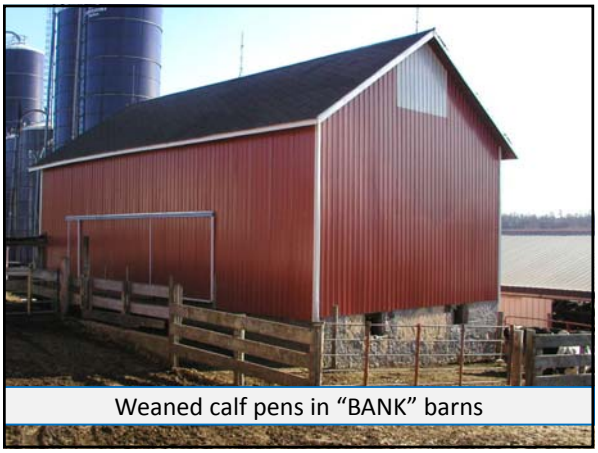
Tube in open-front weaned heifer barn


Use of tubes in MECHANICALLY ventilated buildings


- Can't do natural ventilation
- Negative pressure – can't distribute air into pens on consistent basis, especially at low-volume rates as in cold weather


Tubes in old stall barn retrofitted for calves


Weaned calf pens in "BANK" barns

Tube in dead-ended "BANK" barn

Approximate costs

- Fan – range from $250-800
- Tube, cable, and clamps –
  - range from $7-50 per linear meter
- Power cost (USA)
  - Example: 20-inch fan consumes 500 watts or 0.5 kWh = 12 kWh per day = 4,380 kWh per year.
  - Annual electrical costs = $438 per year at $0.10 per kWh

Topics

Field study of calf barn respiratory disease risk factors

Limitations of natural ventilation

↘ Features of "New Generation" tubes

Comments on drainage and calf groupings/social stress

Some example barns

Some drainage, please!

- Solid concrete flooring without drainage below bedding is a calf heath risk
- Long straw does not absorb liquids quickly, so many place layer of sawdust, shavings, etc, to keep liquid from running from the concrete-based pen
- Bedding becomes a wet "sponge"
- Our field study showed an AVERAGE dry matter of 48% (range 27-68)
  - (5 bedding samples/pen x 15 pens x 13 barns=975 samples)

Solid concrete floor below bedding

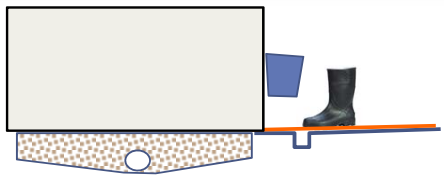
1. Bedding is more wet from soaking up urine, liquid feces, & water
2. Liquids may move out of pen onto service alley floor

Avoid having caregivers stepping into pen drainage and tracking it around the barn

Let's re… slopes!

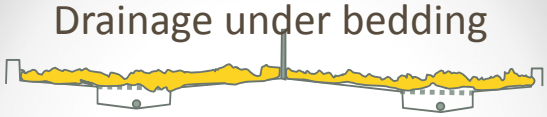
- Co… …por sloped to… …in ce… wo… …rain = foot traf…
- To re… …age from straw, … …havings, sawdu… …below straw…
- Results = … …t traffic

Drainage below the bedding



- Drainage BELOW bedded area
- Minimize water use in central alley (use a waste liquid cart, don't dump milk and rinse on floor, etc)
- More sweeping of central aisle, less washing

Drainage under bedding



- Base is ~1.5 ft gravel, with 4" drain tile to carry liquid to outside storage
- Remove small amount of gravel with straw when cleaning, replace
- Entire gravel & tile base will plug and need to be replaced every 1-3 years
- ~60% of the straw used to achieve equivalent "nest" and improved dryness compared to full concrete base

Area below pen has drained gravel base

"All-in, all-out" minimizes disease transmission from older to younger calves

"All-out" allows for cleaning and 1-week rest

Topics

Field study of calf barn respiratory disease risk factors

Limitations of natural ventilation

Features of "New Generation" tubes

↘ Drainage and social stress

Two barns with preferred features

Key features of preferred calf barns

1. Spatial allowances of approximately 30 ft² or more of bedded space per calf not including service alleys
2. Deeply bedded surfaces in weather less than 50° F
3. Drainage below the bedding
4. Multiple "all-in, all-out" barns with "down" time for cleaning
5. Natural ventilation with positive pressure supplemental ventilation
6. Minimal solid sidewalls, limited to ~24" height

Individual pen nurseries

Four separate "all-in, all-out" barns, serviced from a utility room separate from nurseries

Barn base of "screenings", straw winter bedding

Barn base of "screenings", sand summer bedding

Separation panels alternate solid and mesh allow for some social interaction, yet reduced disease risk

Natural ventilation supplemented with PP tubes

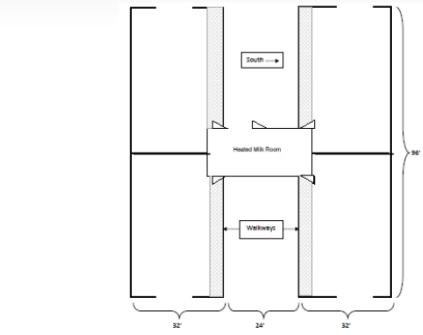
Originally constructed for natural ventilation only, positive pressure tubes added after a year

Automatic feeder nursery

Four separate “all-in, all-out” pens with one common service room

Automatic feeder nursery

with four separate “all-in, all-out” rooms



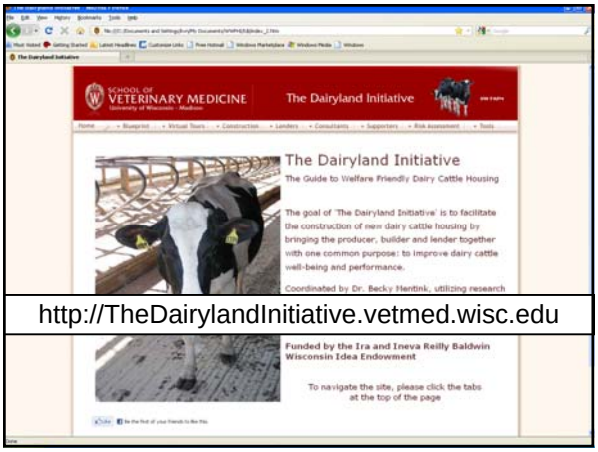
One entrance to barn (except for bedding/cleaning)

Footbaths at entrance to room plus all four calf pens

Newborn calves in individual pens for acclimation period, then move into group pen beyond. Individual pens removed as group pen fills.

Floors sloped to central drainage trough with 25 cm pea gravel over tile drain to outside storage

Natural ven ous central winter tube eather tubes



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Summary

- Use positive-pressure tube ventilation systems to deliver fresh air to calf without a draft
- Avoid cold-stress in cold using DEEP straw, calf jackets, and sometimes infrared heaters
- Drainage below bedding improves nesting and reduces risk of enteric disease spread
- Alternating solid and mesh panels are a social and health benefit
- "All-in, all-out" groups reduce disease risk