CREATING A PRODUCTIVE ENVIRONMENT FOR CALVES IN GROUP HOUSING

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Threats to Calf Health & Growth
- Fecal-oral transmission of organisms
- Animal-to-animal transmission of organisms
- Poor air quality
- Airborne pathogens
- Filth
- Drafts
- Extreme cold & heat

Source: Wolfgang, 2009

Calf Housing Basics
- Dry, comfortable resting area
- Excellent air quality
- Good access to feed & water
- Confident footing

“Allows the opportunity for calves to be more productive.”

Other Desirable Features
- Good observation & access
- Simple handling & restraint
- Easy feeding
- Easy cleaning

“Allows opportunity for caregivers to be more productive.”

Group Calf Housing
- Creating a comfortable environment

Dry, Comfortable Resting Area
- Dry, erect hair coat
- Helps retain body heat in cold weather
- Promotes cleanliness
- Reduces feet & leg problems
Group Pen Design

- If calves are started in individual pens
  - 4' wide x 8' long
  - Solid sides
    - ~4' high
    - Easy to clean material
  - Adjustable rear panel
    - Solid 18” – 24” from floor
  - Hover?

Group Calf Space Requirements

- Good access for bedding removal & addition

Can soiled bedding be removed while pen is occupied?

Group Pen Design

- Group size
  - 2 to 30 calves

- Age range
  - Fill group in 7 to 10 days

Group Pen Design

- Bedded space (not including feeding area)
  - 25 – 50 ft²/calf
  - Depends on bedding management
  - Generously bedded
  - Well-drained

Recting area should be dry at all times

Penn State Extension

Concrete Base

Earth Base

Image courtesy of R.E. Graves
Group Calf Space Requirements

- Good access for bedding removal & addition

Feeding Calves in Groups

- Water
  - Free-choice
  - Frost-free
  - Easy cleaning

- Grains
  - 18” per calf?

Group Calf Space Requirements

- Feeding area
  - Stable 6 – 8 ft wide pad
    - Paved or perforated
    - Well-drained
    - Confident footing
    - Slope to drain

- Allow for ‘idle-time’ between occupants
  - Reduce pathogen transmission
  - 7 to 14 days ‘idle’
  - 15 – 25% more pens than groups

- Allow for ‘bulges’ in calving & heifers
  - Allow for group expansion within pens
  - Consult farm records
**Ventilation System Goals**
- Provide air exchange – control levels of moisture, gases & pollutants
- Uniform distribution of fresh air – throughout entire animal space.
- Protection from weather extremes
- Minimize drafts

**Ventilation Seasons**
- **Cold season**
  - Adequate air exchange
  - Protection from cold winds & precipitation.
  - Protection from drafts
  - < ~50 fpm

**Ventilation Seasons**
- **Warm season**
  - Adequate air exchange
  - Control moisture, gas & pollutant levels
  - Remove excess heat
  - Provide shade
  - Reduce radiant heat load
  - Forced convection
  - Reduce heat stress
  - Remove ‘hot’ spots

**Warm & cold seasons transition**
- Respond to temperature fluctuations

**Suggested Ventilation Rates for Calves**
- **Per calf method:**
  - Cold weather (continuous) rate: 15 cfm/hd
    - Fresh air, moisture control
  - Mild weather rate: 50 cfm/hd
    - Moisture removal, temperature modification
  - Warm weather: 100 cfm/hd
    - Reduces heat build up, increase air movement

**Suggested Ventilation Rates for Calves**
- **Air exchange method** (air changes per hour):
  - Cold weather (continuous) rate: 4 to 6 ACH
  - Mild weather rate: 10 to 15 ACH
  - Warm weather rate: 30 ACH
  - Hot weather rate: 60 ACH

\[
Q \text{ (cfm)} = \left\{ \frac{\text{Building Volume (ft}^3\text{)} \times \text{Desired Number of ACH}}{60 \text{ minutes/hour}} \right\}
\]
Ventilation System Alternatives

- Natural
- Mechanical
- Combination

Natural Ventilation
- Air exchange driven by wind

Natural Ventilation
- Air exchange driven by animal heat
  - Not much with calves

Negative Pressure Mechanical Ventilation
- Exhaust fans lower the static pressure in the animal area
  - Air distribution & mixing relies on a slight pressure differential
Positive Pressure Mechanical Ventilation

Inlet fans increase the static pressure in the animal area. Inlet duct distributes fresh air evenly.

Neutral Pressure Mechanical Ventilation

‘Equal’ capacity inlet & exhaust fans result in little or no static pressure difference in the animal area.

Naturally Ventilated Group Calf Buildings

- Curtain Both Sides
- Open Front - Curtain Back

NV for Group Calf Buildings

- Building exposure
- Building orientation
- Building separation
- Building features
NV Group Calf Building Features

- Sidewall height
  - 10’ to 12’
  - Clearance for equipment
- Sidewall opening
  - Adjustable up to 80 to 100%
  - Keep pens away from sidewall
- End wall opening & adjustment
  - End walls are sidewalls too!

NV Group Calf Building Features

- Roof frame type
  - Gable (symmetrical or asymmetrical)
- Roof slope
  - Typically 3:12 or 4:12
- Eave extension
  - 1/3 sidewall height

NV Calf Building Features

- Ridge opening
  - Continuous: 2” per 10’ building width (8” minimum)
  - Stacks: ½ ft² per 100 ft² floor area; 40’ or less apart
  - Adjustable?
- Eave opening
  - One-half total ridge opening per side

NV Calf Building Features

- Insulation
  - Reduces radiant heat load in summer
  - Reduces condensation
  - Select bird resistant materials

NV Calf Building Features

- Control
  - Automatic control is best
  - More uniform air quality in animal space

Natural Ventilation Management

- Cold / Mild Weather
  - Protection from cold winds & precipitation
  - Protection from drafts
  - Maintain desirable levels of moisture, gases & pollutants
  - Inside $T_{db}$ with 5 - 10°F of outside $T_{db}$
  - Proper nutrition & bedding
Comfort Zone for Dairy Calves

- Newborn:
  - 58°F to 78°F

- At one month:
  - 32°F to 73°F

Generous Bedding Layer

- Nesting Level One
  - Calf resting on top – legs exposed

- Nesting Level Two
  - Calf nestles into bedding – part of leg exposed

- Nesting Level Three
  - Calf nestles deeply in bedding – legs not visible

Comparison of Pen Design & Bedding Options

Draft Protection

Natural Ventilation Management

- Warm weather
  - Provide shade
  - Breezes at animal level
Challenges in NV Calf Buildings

- Closed curtains in cool / cold weather
  - Inadequate air exchange
- Periods of little natural airflow
- ‘Wide’ buildings
  - Uneven air distribution & mixing
- Drafts

NV Calf Buildings with Group Pens

- Cold weather pressure ventilation

4 to 6 air changes per hour (ACH)

Mechanical Ventilation

- More predictable air exchange & distribution
- Less affected by outside terrain & obstacles
- Better temperature control?

- Higher initial cost
- Higher operating cost
- May require more maintenance
- Back-up power

Mechanical Ventilation

- Design exchange rate range:
  - Infinite from exchange between minimum & maximum rate

Multiple Fans  Adjustable Inlets  Accurate Controls

Sidewall & Ceiling Insulation
Fresh Air Inlet Placement

- Buildings to about 38' wide
- Buildings to about 48' wide
- Buildings over 48' wide

Controls

- Adjust ventilation rate & inlet openings
- Position sensors for accurate measurement
  - At convenient height over service alley

Monitor Conditions

- Moisture level
- Gas levels
- Pollutant levels
- Temperature
- Temperature fluctuations

Mechanical Ventilation Example

- 100 calf building

<table>
<thead>
<tr>
<th>Ventilation Rate</th>
<th>Per Head Method (cfm)</th>
<th>Air Change Method (cfm)</th>
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</thead>
<tbody>
<tr>
<td>Cold Weather</td>
<td>1,500</td>
<td>3,867</td>
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<tr>
<td>(Continuous)</td>
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<tr>
<td>Mild Weather</td>
<td>5,000</td>
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<tr>
<td>Warm Weather</td>
<td>10,000</td>
<td>23,200</td>
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<tr>
<td>Hot Weather</td>
<td>~</td>
<td>46,400</td>
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</tbody>
</table>

Building Dimensions: 58’ x 100’ – 10’
Animal Space: 58’ x 80’ – 10’
Mechanical Ventilation Example

To Keep Calves Healthy

Questions?