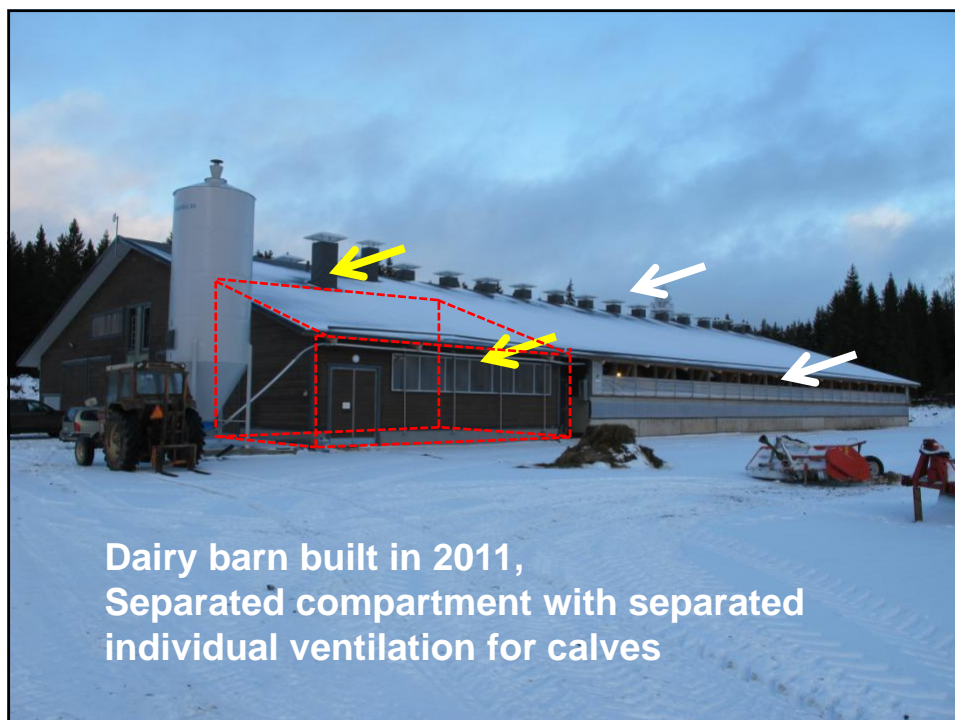




## Positive pressure tube ventilation For calf barns

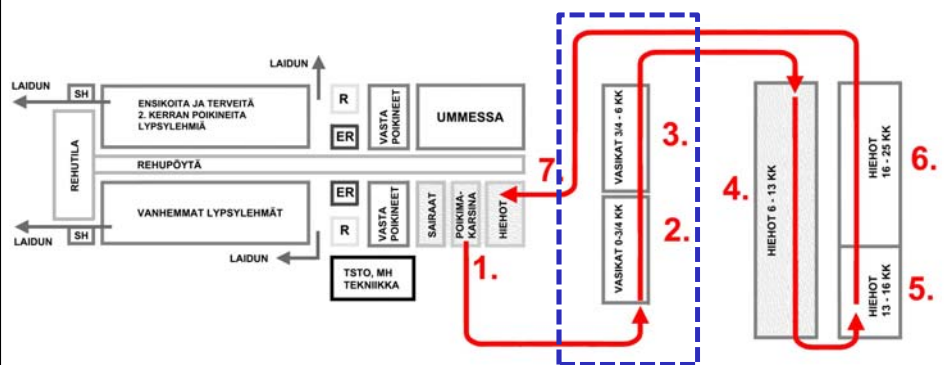
**Tapani Kivinen**  
**MTT**  
**AgriFood Research Finland**  
Animal Production Research



Dairy barn built in 2011,  
Separated compartment with separated  
individual ventilation for calves



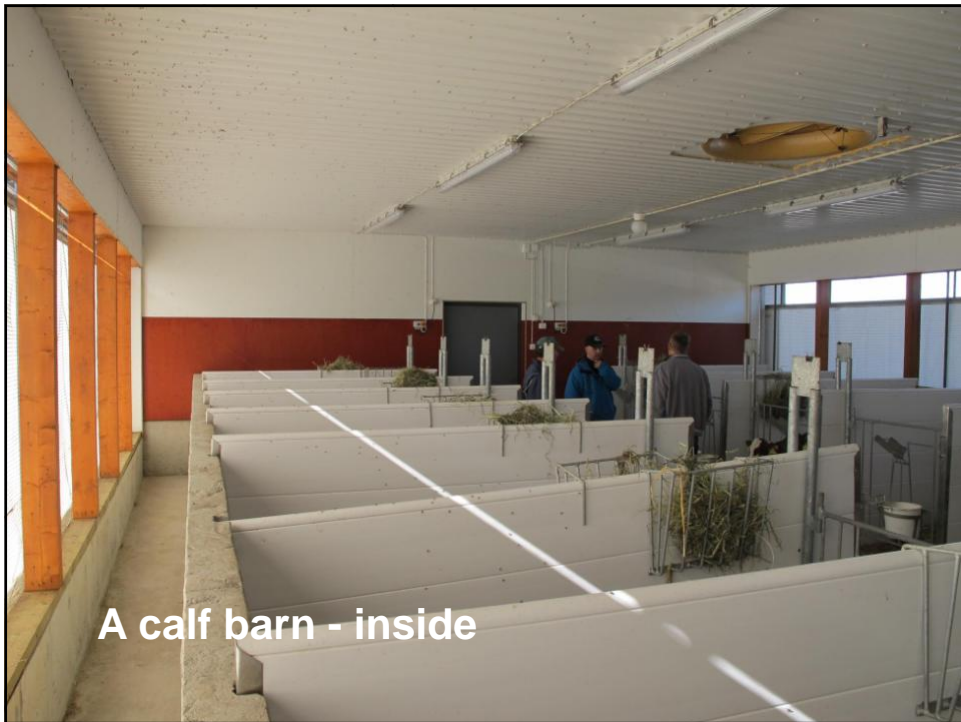
Today we recommend dairy producers to build  
separate buildings for milking cows, calves and  
heifers



Reason: disease prevention

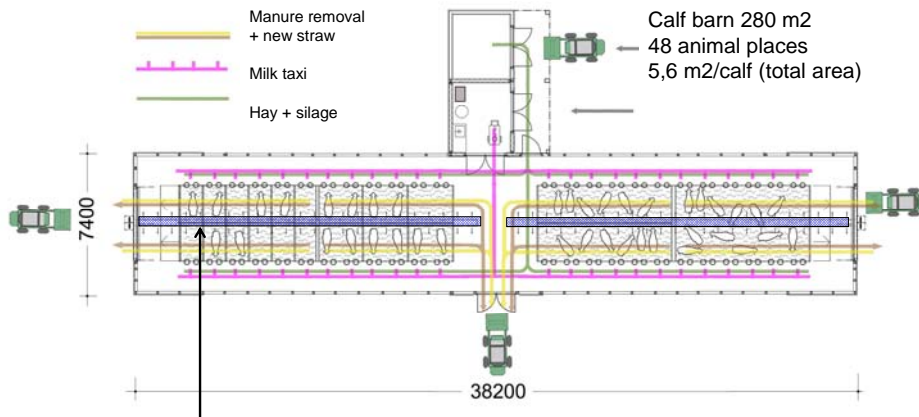


A calf barn - outside



A calf barn - inside

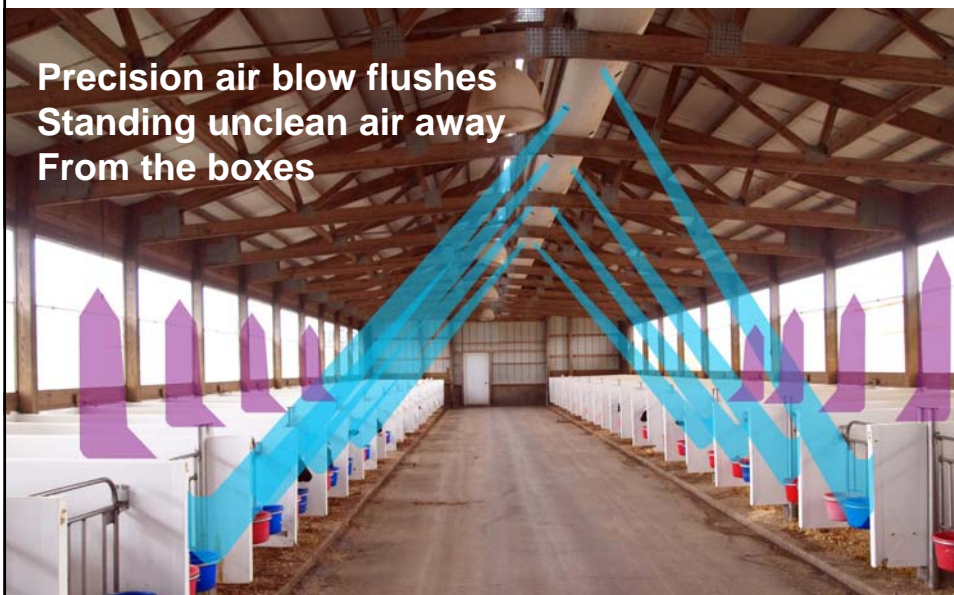
## Simple and functional calf barn (expandable)



Positive pressure tube for blowing air into the barn

**Positive pressure means slight over pressure,  
However it has no negative impact on constructions because  
air escapes freely through curtains, chimneys, doors etc.**

**Precision air blow flushes  
Standing unclean air away  
From the boxes**





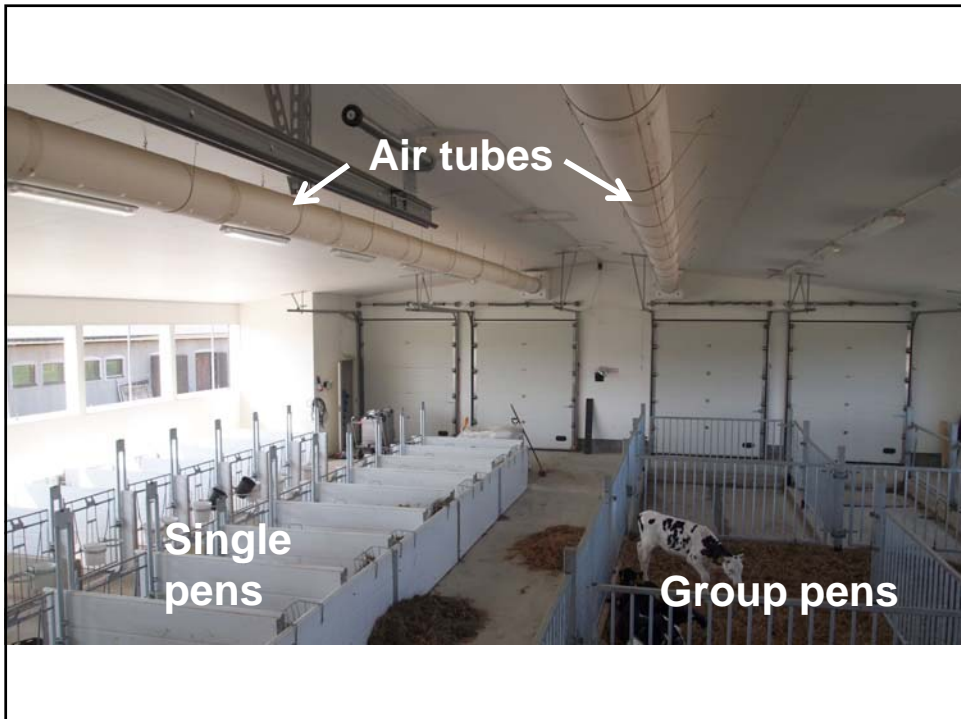
**Tube system is aplicable in old barns, too.**



**Tube system is aplicable in old barns, too.**



**A new calf barn in Middle Finland**  
Where measurements were done



**Air tubes**

**Single pens**

**Group pens**

## Planning tool = excel based programm

| Dimensions of barn           |   | Fan sizing and selection                                   |  |
|------------------------------|---|--|--|
| Length                       | 37.01 ft / 11.28 m                        | Min. ft <sup>3</sup> /min per animal                       | 30 ft <sup>3</sup> /min / 0.014 m <sup>3</sup> /s                  |
| Width                        | 20.00 ft / 6.10 m                         | Total cfm based on animal #                                | 237 ft <sup>3</sup> /min / 0.112 m <sup>3</sup> /s                 |
| Minimal interior ht          | 7.00 ft / 2.13 m                          | Total cfm for 4 air changes/hr                             | 419 ft <sup>3</sup> /min / 0.198 m <sup>3</sup> /s                 |
| Maximum interior ht          | 10.00 ft / 3.05 m                         | Volume of barn/animal                                      | 786 ft <sup>3</sup> /animal / 22.27 m <sup>3</sup> /animal         |
| Interior volume of barn      | 6291 ft <sup>3</sup> / 178 m <sup>3</sup> | Fan cfm rating at 0% H <sub>2</sub> O                      | 676 ft <sup>3</sup> /min per fan / 0.319 m <sup>3</sup> /s per fan |
| Maximum # of animals         | 8 head                                    | Est. fan ft <sup>3</sup> /min at 0.15 % H <sub>2</sub> O   | 575 ft <sup>3</sup> /min per fan / 0.271 m <sup>3</sup> /s per fan |
| Tube specifications & height |   | Aperture ratio, discharge coefficient, and static pressure |  |
| Length of tube               | 36 ft / 10.98 m                           | Area, one "set" of holes                                   | 2.1 in <sup>2</sup> / 13.6 cm <sup>2</sup>                         |
| Diameter of tube             | 10.0 in / 25 cm                           | Number of "sets" of holes                                  | 33 sets  |
| Proximal tube air speed      | 1053 ft/m / 5.35 m/s                      | Aperture ratio (a <sup>2</sup> /A)                         | 0.30   |
| Length/diameter ratio        | 43  | Discharge Coefficient C <sub>discharge</sub>               | 0.62   |
| Height, bottom of tube       | 8.0 ft / 2.44 m                           | Static Pressure  | 0.15 % H <sub>2</sub> O / 36.7 Pascals                             |
| Air speeds                   |   | Spacing of perforated holes                                |  |
| Target air speed             | 60 ft/m / 0.30 m/s                        | Hole intervals   | 13 in / 33 cm  |
| Discharge speed from holes   | 1175 ft/m / 5.97 m/s                      | Clock position of Holes                                    |  |
| Diameter of holes            |   | Expected throw distance to target air speed                |  |
| Row 1, hole diameter         | 1.25 in / 3.2 cm                          | Trajectory distance to target                              | Horizontal distance to target                                      |
| Row 2, hole diameter         | 0.75 in / 1.9 cm                          | Height at target   | Height at target   |
| Row 3, hole diameter         | 0.75 in / 1.9 cm                          | Speed  | Speed  |
| Row 4, hole diameter         | 0.00 in / 0.0 cm                          | Expected throw distance, Metric                            | Expected throw distance, Metric                                    |
|                              |   | Trajectory distance to target                              | Horizontal distance to target                                      |
|                              |   | Height at target   | Height at target   |
|                              |   | Speed  | Speed  |
|                              |   | Expected throw distance, Metric                            | Expected throw distance, Metric                                    |
|                              |   | Trajectory distance to target                              | Horizontal distance to target                                      |
|                              |   | Height at target   | Height at target   |
|                              |   | Speed  | Speed  |

Designed by Dr. Ken Nordlund et al. – University of Wisconsin USA

## Using the "Positive Pressure Tube Calculator, Version 5.0" to design positive pressure tube ventilation systems for calf barns

Ken Nordlund, DVM, Arturo Gomez, DVM, Tom Bennett, BS, Rebecca Brotzman, DVM  
 School of Veterinary Medicine  
 University of Wisconsin-Madison  
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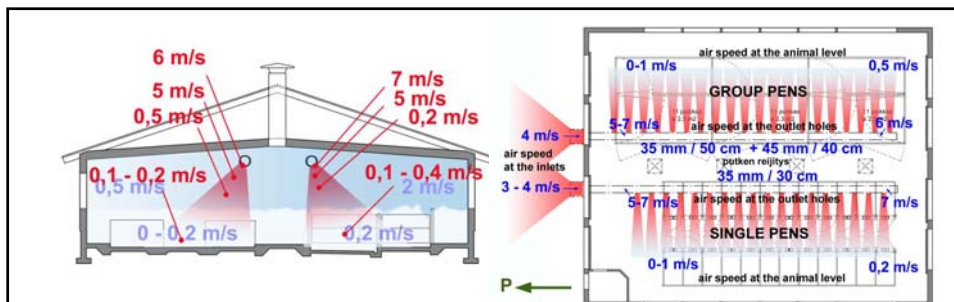
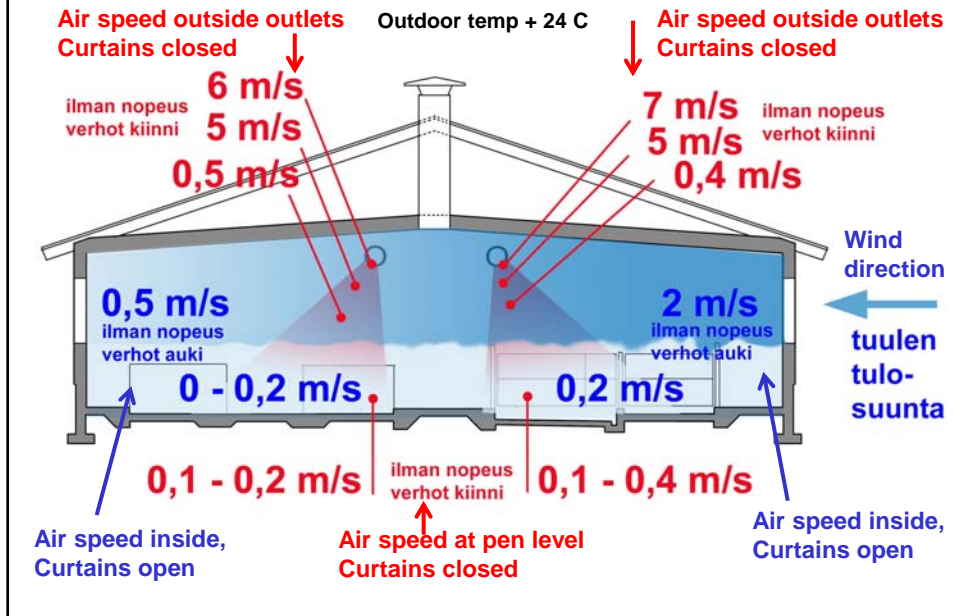
### INTRODUCTION

This paper supports the Excel spreadsheet "Positive Pressure Tube Calculator, Version 5.0." Developed in 2011 and modified in 2012, the spreadsheet is used in the design of new positive pressure tube systems for calf barns. It can also be useful for the analysis of the performance of existing systems. The calculator is also useful for the design of tube systems for use in heifer and adult cattle environments, providing heat abatement and ventilation with fresh air. The scope of this paper will focus on the design of calf barn systems, followed by a discussion on the analysis of existing systems.





## Second measurement, curtains closed

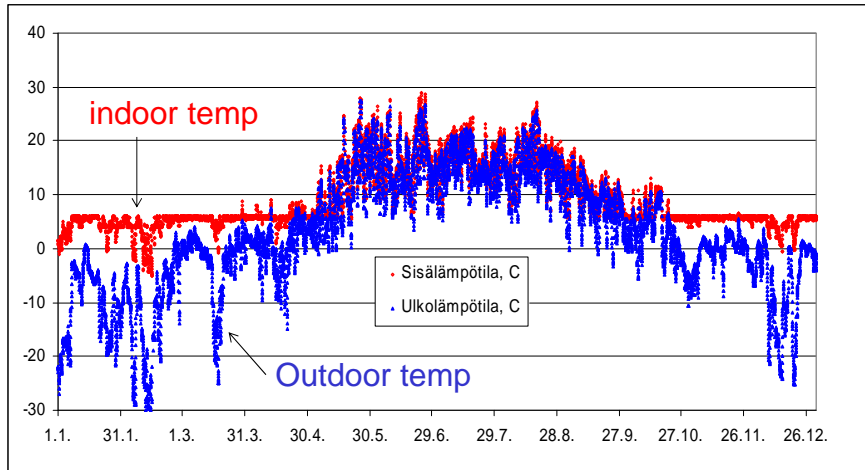


### Positive pressure tube ventilation performance

Spatial volume is 1020 m<sup>3</sup> (15 x 20 x 3,4 m)  
Blown air quantity is 1900 m<sup>3</sup> per hour  
This is equivalent to 1,9 (2) changes per hour  
No harmful draught on animal level

**This can be considered as sufficient basic ventilation rate!**  
**When the target is to flush the boxes at animal level!**  
(in winter, curtains closed)  
(in summer, no wind)

Typical outdoor and indoor temperatures (hour by hour) in natural ventilated curtain barn for 120 dairy cows in Finland  
 (measurements and simulation 2011 by VTT & MTT)



**Air exchange rate and outdoor temperature in naturally ventilated dairy barn with curtains**

(measurements and simulation 2011 by VTT & MTT)

