Case Study : Initial : Temperature Differences within ACNV building

Building housing about 1000 weaners, roughly 35 metres by 18 metres.
Ventilation by curtains, one on each side (35 metres) running the length of building, treated as two zones. Two sensors on each side (i.e. one in each quarter).
Initial study is of data for a period of 43 hours.

The Building is maintaining temperature adequately (at the ambient temperature experienced). See Chart 1

The average temperature is 21.35ºC, compared to a target temperature of 21ºC.
Average temperatures in each quarter differ slightly -

	Mean TempºC	Diff from Room Mean ºC	Diff from Zone Mean ºC
Room Mean	21.35	-	-
Zone 1 Sensor 1	22.40	+1.05	+0.43
Zone 1 Sensor 2	21.54	+0.17	-0.43
Zone 2 Sensor 1	21.56	+0.21	+0.82
Zone 2 Sensor 2	19.91	-1.44	-0.82
Zone 1	21.97	+0.62	-
Zone 2	20.74	-0.62	-

Zone 1 is slightly warmer on average than Zone 2 (+0.62ºC)
Sensors at one end of the building are slightly warmer (Sensors 1) on average than the other end (+0.43, +0.82 = 0.61ºC)

Whilst this shows the average differences - which are modest - the dynamic differences are somewhat greater, as shown by the first temperature chart. Typically the range within the building is around 3 to 4ºC.

The succeeding charts show curtain positions on respective sides of the building, and end to end differences (labelled Diff).

When comparing the differences between the mean in the two zones, it should be noted that the middle period is markedly different from the beginning and end periods. Noting the very sudden change in the characteristic, it is most probably due to a marginal change in wind direction and or speed.

Overall, the larger differences experienced are end to end - that is, within the zones, rather than between the zones. That this should be so should hardly come as a surprise, for two reasons -

Firstly, the greater distances are within the zones. In a naturally ventilated building, air flows through the building - in one side and out the other, or even in at one point and out at another on the same side, depending wind direction, speed and so on. In flowing through, it picks up heat from animals and becomes progressively warmed along the air path, rising in temperature and creating a temperature gradient. The longer the air path, the greater the potential difference.

Secondly, the control system can position curtains differently for different zones - thereby reducing temperature differences between zones to some extent - but can have no effect whatever on temperature differences within a single zone.

It should be noted that the regulation of curtains can only have **some** effect on temperature differences between zones in an ACNV building, since ventilation is dependent on wind speed and direction. For example, if air is flowing only from Zone 1 to Zone 2, then Zone 2 receives pre-warmed air, and only so much as is available from Zone 1, and would therefore be hotter than Zone 1. Opening further, or even completely, will not ventilate Zone 2 to any greater degree. It will only provide more cooling if it in some way finds another source of ventilation - such as stack effect, or peripheral wind eddies.

In this particular case, concern has been expressed about the temperature differences between one side and the other within a short time of the controller being installed. (New controller, long existing ventilation system.) In particular, there was an impression that the higher temperature appeared to be on the windward, rather than leeward side of the building (suggesting, possibly, some kind of control malfunction).

Without an anemometer, no conclusions can be made as to the effect of wind speed or direction. Logged data from another site in the general geographical area indicates winds were generally ESE to SSW (i.e. mostly southerly) during this period, though how this relates to the building concerned is not certain, nor how other buildings on the site may create local eddies.

Due to the relatively brief period of logging, no particular conclusions can be made as to temperature differences between the sides of the building (i.e. one zone to another), and how these may change in the longer term.

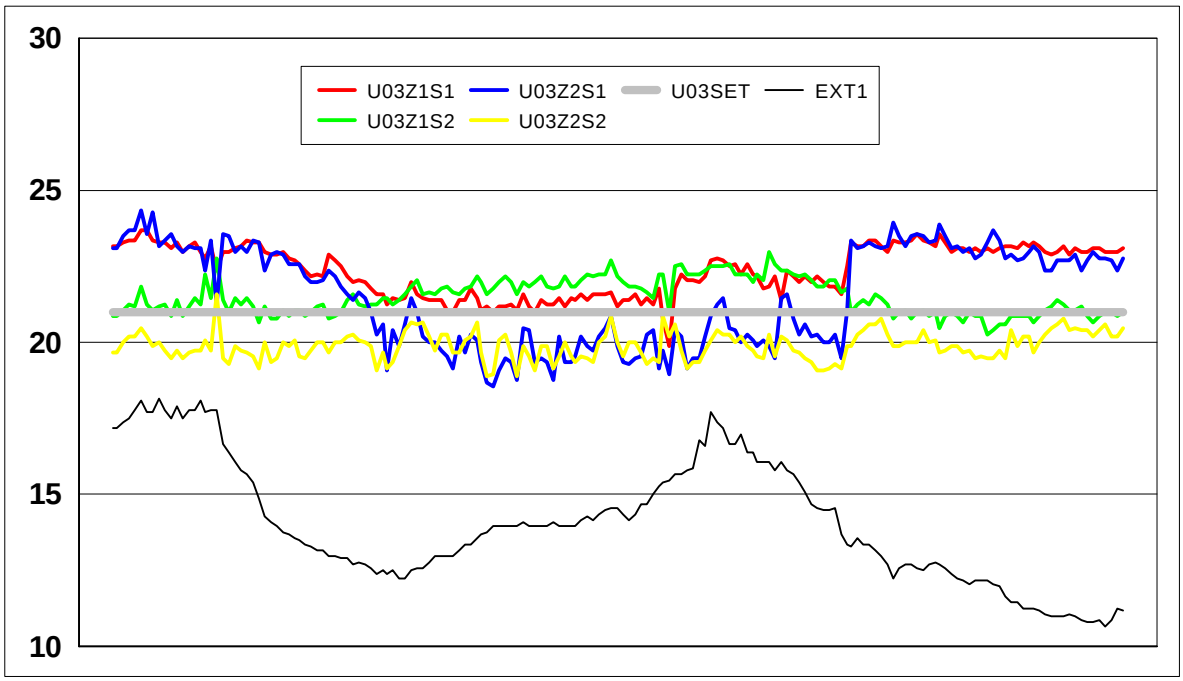
The charts show that, broadly, temperature differences within zones - i.e. along the length of the building - tend to increase as a function of curtain position. However, it should be remembered that curtain position is not an independent variable.

For example, if we assume heat output (by animals to be roughly constant) then for any particular outside temperature, a lower wind speed will mean a more open curtain. That is, a more open curtain can be taken as an indication of a lower wind speed. So, within certain bounds, we would expect air to be moving more slowly, with less air mixing, and thereby creating perhaps greater temperature gradients.

Strong conclusions cannot be drawn regarding temperature differences within the zones, at this point, though it should be noted that these are larger than the between zone differences which were initially alerted.

Depending on longer term results, consideration should be given to dividing curtains along the length - i.e. breaking up the existing zones into two or three sections. Clearly, this would involve greater cost, and would only be justified if there are either identifiable effects on animal productivity, or reasonable grounds to feeling they may be present.

General Comment : It often seems the case that the control and regulation of curtain systems are based on mechanical convenience, rather than animal requirements.


30
25
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U03Z1S1
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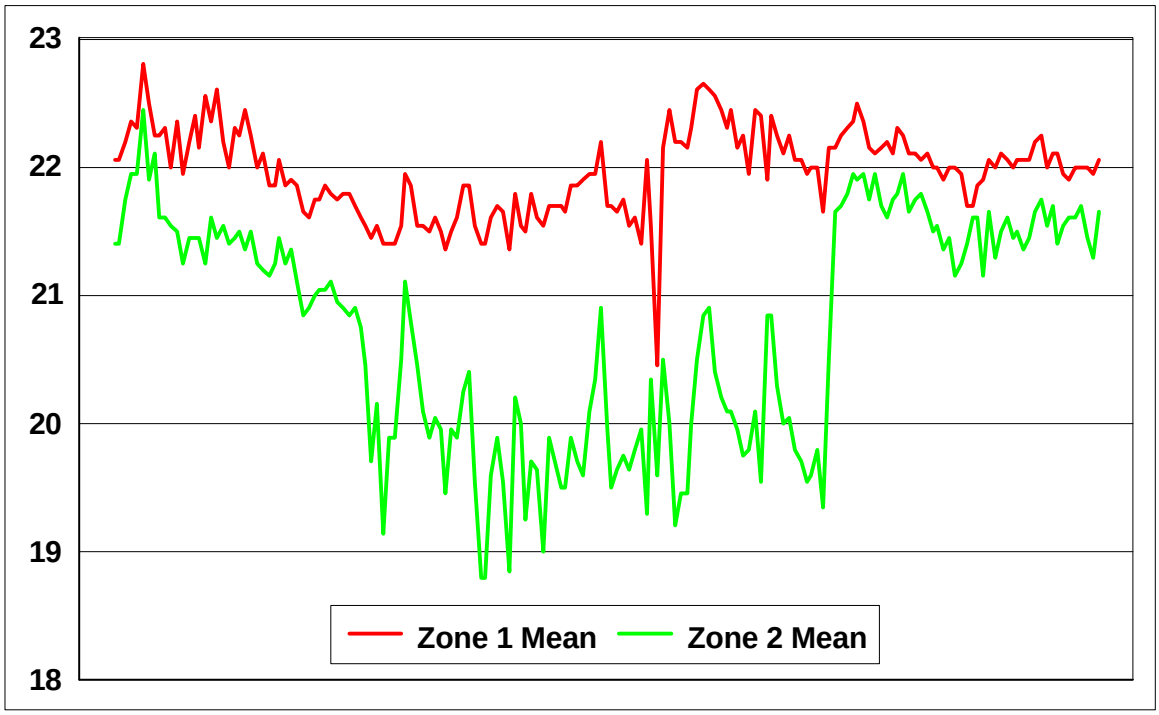
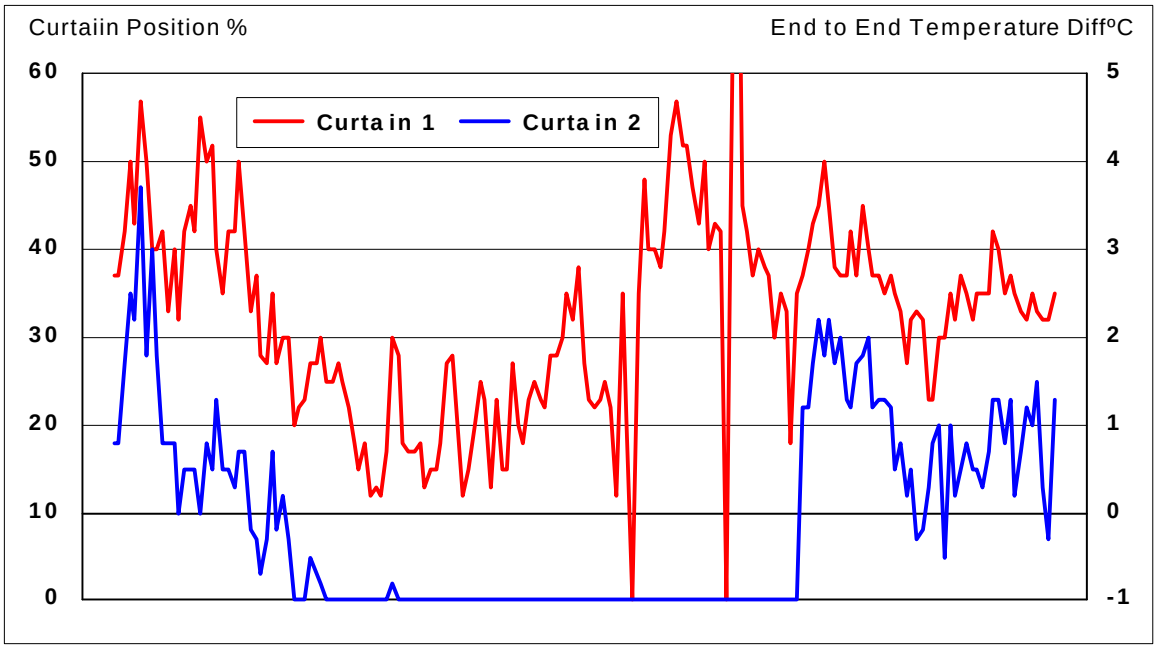
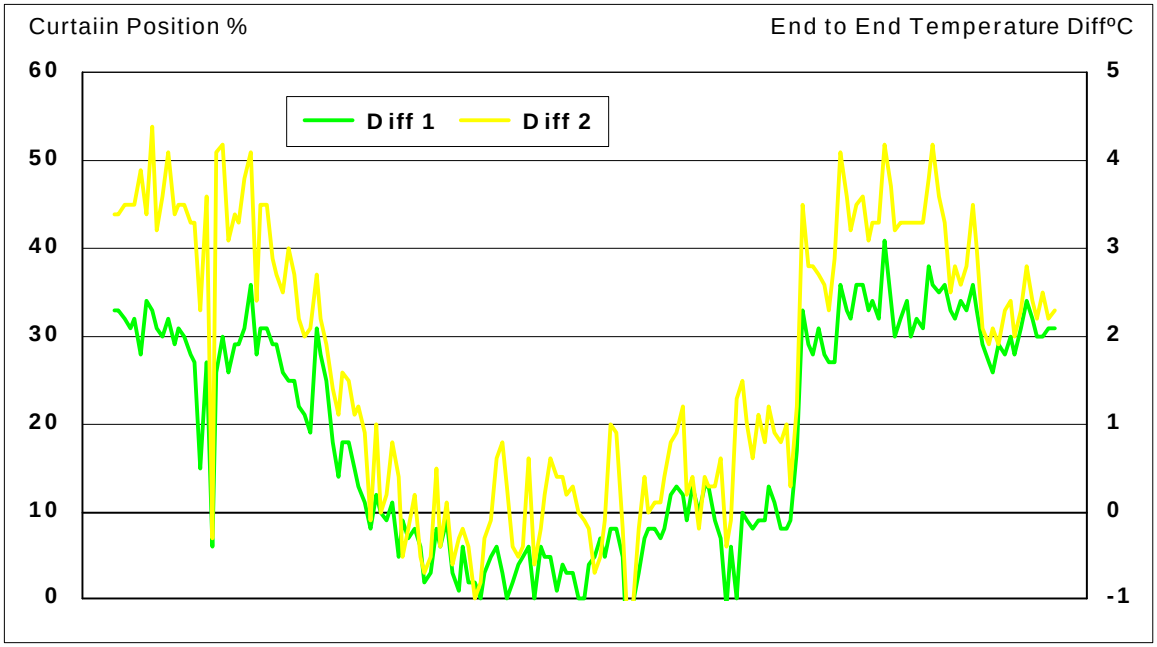

23
22
21
20
19
18
Zone 1 Mean
Zone 2 Mean


Curtaiin Position %
End to End Temperature DiffºC
Curtain 1
Curtain 2
60
50
40
30
20
10
0
5
4
3
2
1
0
-1


Curtaiin Position %
End to End Temperature DiffºC
Diff 1
Diff 2
60
50
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