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1. INTRODUCTION

This volume contains a database of the results of the computational fluid dynamics (CFD) simulations for the research done on the National Institutes of Health *Ventilation Design Handbook on Animal Research Facilities using Static Microisolators*.

Section 1 contains an overview of the basic room configuration studied and the variations considered. It is impossible to present all the data generated by the CFD simulations. The analysis of all the results produces an enormous quantity of data that would be difficult to present and interpret in its entirety. This volume contains summaries of the data in several forms.

Section 2 contains histograms of mean values for each room considered, as they apply to both the scientists' breathing zone and the cages, for temperature, relative humidity, and CO₂ and NH₃ concentrations.

Section 3 contains rankings of the rooms based on different variables, for example, the selection of the room configuration with the lowest NH₃ concentrations in the cages.

Section 4 contains a two page summary of each room simulation, including a description of the room, mean values and standard deviations for all parameters, and histograms showing the distribution of values in the cages.

1.1 Outline of CFD Baseline Model

A typical animal research facility of average size, air change rate, rack layout, mouse population, pressurization, and so on, was modeled as the baseline model for the CFD simulations. The general features of the room are shown in figure 1.01 and are listed below.

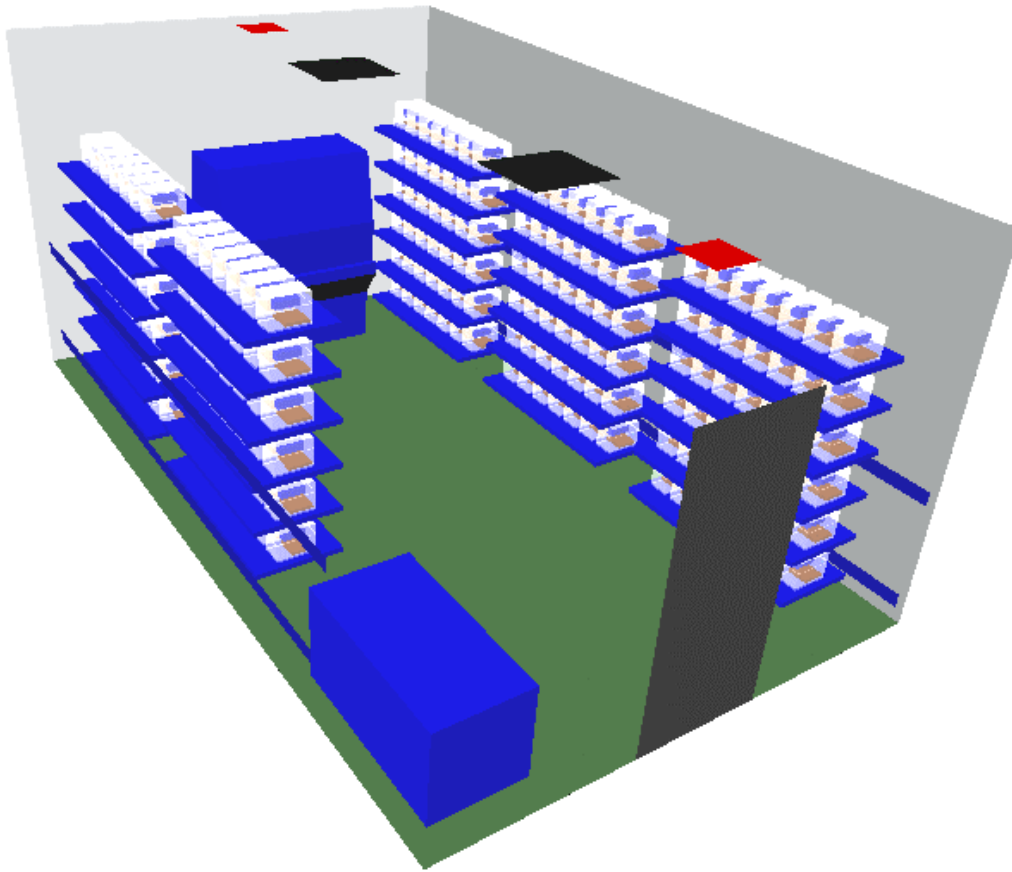


Figure 1.01 Overall Layout of Animal Room Basecase

Description in brief

The general features of the basecase room model were:

Room: 6.10m x 3.60m x 4.22m (20' 0" x 12' 0" x 9' 0")

Door in short wall

Sink in corner

Laminar flow change station

5 racks

Cages: Microisolator (with filter top) mouse cage

5 mice per cage

Rack: Static system

6 shelves per rack

7 cages per shelf (42 cages per rack)

Supply: 2 radial supplies each providing 270cfm (0.13m³/s) for a total of 15 ACH
Supply discharge temperature of 18.8 °C (66 °F), set such that the exhaust air temperature was 22.2 °C (72.0 °F)
61 percent relative humidity (to provide 50 percent RH at 22.2 °C (72.0 °F))

Exhausts: 2 ceiling level exhausts removing 220cfm (0.1m³/s) each

Makeup Air: 100cfm (0.047m³/s) coming from around the door

Overall Geometry

In the majority of the cases considered, the animal room occupied a floor area of 6.10m (20' 0") x 3.66m (12' 0"). In some cases that were considered, the width of the room was increased from 3.66m to 4.22m (14' 0"). The ceiling height in all cases was 2.74m (9' 0"). There was only one door in the room, mounted centrally on one of the short walls.

In all the displacement ventilation systems considered in this project, air was introduced through ceiling mounted diffusers. All devices were mounted flush with the ceiling surface; there was no ductwork present within the upper room volume. The various diffuser types considered in this project were all modeled using a combination of several boundary conditions that were validated previously (see volume I, section 4.2.2). All the air exited through general exhausts. The number and locations of the exhausts were varied. In line with common practice, there was an imbalance between the amount of air supplied to the room and exhausted from the room. This leads to an overall pressurization of the room relative to the rooms or corridors surrounding the room. The relative level of pressurization was a parameter considered in this study. The makeup air to compensate for the supply/exhaust imbalance was allowed to enter or leave the room through 6.35e-3m (0.25") gaps on three sides of the door.

The rooms considered in this project all contained five animal cage racks. The rooms also contained one of two alternative design change stations. A fuller description of these items is given below. The only other item within the room was a sink of 0.61m (24") x 0.61m (24") x 0.81m (32") that was situated in one of the corners to the room.

In all cases, the room was considered under dark period conditions, i.e., the lights were off and produced no additional heat load to the room. Dark period conditions were chosen because early experimental work had indicated that heat, CO₂, and NH₃ generation were higher in the dark period compared with periods in which the lights were on.

Rack Model

The overall dimensions of the rack were 1.52m (60") x 0.61m (24") x 1.83m (72") high, as shown in figure 1.02. There were six shelves in the rack. The spacing of the shelves was 0.32m (12.75") from top surface to top surface, with the lowest shelf at a height of 0.21m (8.25") above the floor. The shelves were modeled as thin rectangular blocks. Details, such as the connecting ties between the shelves and the rollers on which the racks move, were not modeled because their effect on the overall flow field and gas concentration distributions was considered insignificant.

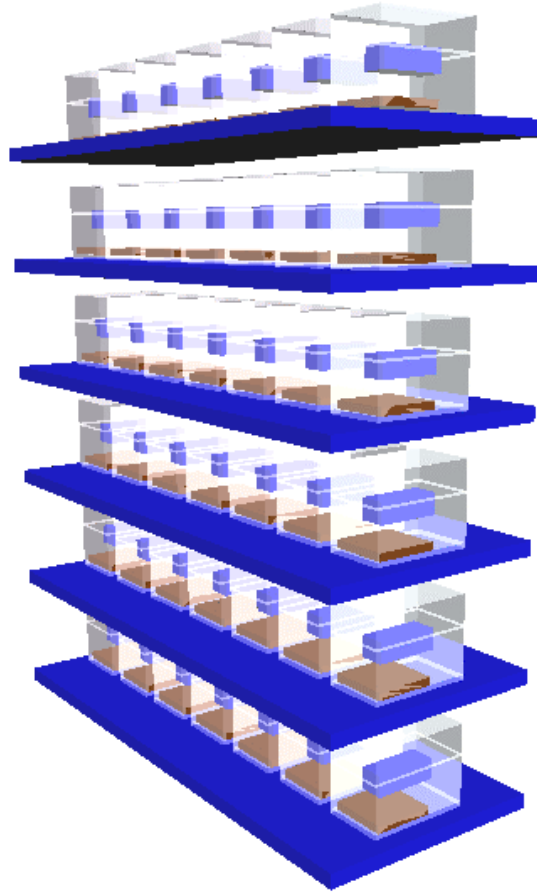


Figure 1.02 CFD Model of Cage Rack

Located on the shelves of the racks were representations of the animal cages, shown in figure 1.02. The dimensions of the cage were 0.27m (10.7") x 0.16m (6.38") x 0.21m (8.39") high, which maintained the volume of the original cage that had sloped sides. The sides of the cage were modeled as thin plates, with the thickness and conductivity of the plates set to those of the physical cage polycarbonate. The water bottle and food normally found in a cage were modeled as a single block in order to reduce the computational overhead. The volume of the block was the same as that of the bottle and food combined. The bedding of the cage was included as a rectangular block of 0.27m (10.7") x 0.16m (6.38") x 1.27e-2m (0.5").

The mice were modeled as a block of 0.11m (4.25") x 8.57e-2m (3.38") x 0.22m (0.88"), the same representation that was used in the experimental cage wind tunnel tests (see volume I, section 4.1.1). This simulated the effect of 'huddling' by the mice. The surface temperature of the block was fixed at 30.0 °C (86.0 °F), which is agreed to be a typical mouse body surface temperature.

Surrounding this block, a source of CO₂ was defined at 2.12e-7 kg/s (0.76g/hr), which was based on the generation rate indicated for the dark period in the early tests on the effect of the

photoperiod on the mice. The supply air was assumed to have a zero concentration of CO₂. This source allowed the additional concentration of CO₂ in the air to be calculated in the simulation. It also allowed the concentration of NH₃, among other things, to be calculated by scaling even though it has a different molecular weight from both air and CO₂. This was possible as the magnitude of the source was very small and the resulting concentrations were so low as to have a negligible effect on the density of the mixture of air, CO₂, and NH₃. In effect, the CO₂ and NH₃ are intimately mixed with, and flow with, the air.

Experimental data later showed the generation rate of CO₂ was actually higher than the source used in the CFD simulations at 0.90 g/hr/100g mouse body weight. This means the concentration of CO₂ in the room and cages was derived from the simulated concentration multiplied by a scaling factor (0.90/0.76). The concentrations of NH₃ in both the cages and the room were also derived by scaling the concentration with a factor specified in the post-processing of the data. This factor was assumed to vary according to the number of days that passed since the bedding in the cage was changed, along with the average relative humidity in the cages. See volume I, section 4.2.1.2 for the experimental determination of the factors.

Background levels of CO₂ and NH₃ were assumed to be zero. This means that all values quoted in the CFD section of the report are relative to the background level. If an absolute value for CO₂ is required, an additional amount in the range of 300ppm to 700ppm should be added for most locations.

The remaining cage boundary conditions are associated with the transfer mechanisms for air/gases to enter/leave the cage. The cracks at the side of the cage were modeled as 6.35e-3m (0.25”) high planar resistances, with the loss coefficient for these resistances having been determined from the cage wind tunnel CFD simulations (see volume I section 4.2.1.2). The top of the cage, which was filtered, was defined as a combination of a planar resistance and a planar source. The determination of the loss coefficient for the resistance, and the coefficient for the source has been outlined (see volume I, section 4.2.1.1).

The spacing of the cages on the shelves was dependent on whether the racks were single density (7 cages per shelf), or double density (14 cages per shelf). In the single density cases, the cages were centrally located in the short dimension, and equally spaced in the long dimension. The spacing was 4.88e-2m (1.92”) from corner of cage to corner of adjacent cage. In the double density racks, the cages were equally spaced in both the long and short dimensions. The spacing was 2.20e-2m (0.87”) and 4.88e-2m (1.92”), respectively.

Change Station Model

Two alternative change stations were considered in this project. Both stations were constructed primarily from rectangular blocks and triangular prisms. The internal structure and flow field were of no concern in this project. It was only the effect of the station on the room airflow that is of importance.

The first design is shown in figure 1.03. The station had overall dimensions of 1.32m (52”) x 0.86m (34”) x 1.83m (72”). This design was effectively passive in terms of direct flow field interaction. In particular, the station internally recirculated a flow of 350 cfm (1.65e-1 m³ /s),

with only 10 percent leakage defined at the sash opening. The makeup air intake for this leakage was mounted at the side of the station. The station dissipated heat that was expected to affect the room's overall flow field. In particular, the station contributed a load of 720W to the room. This heat was mostly confined to the lower portion of the station where the motor was located.

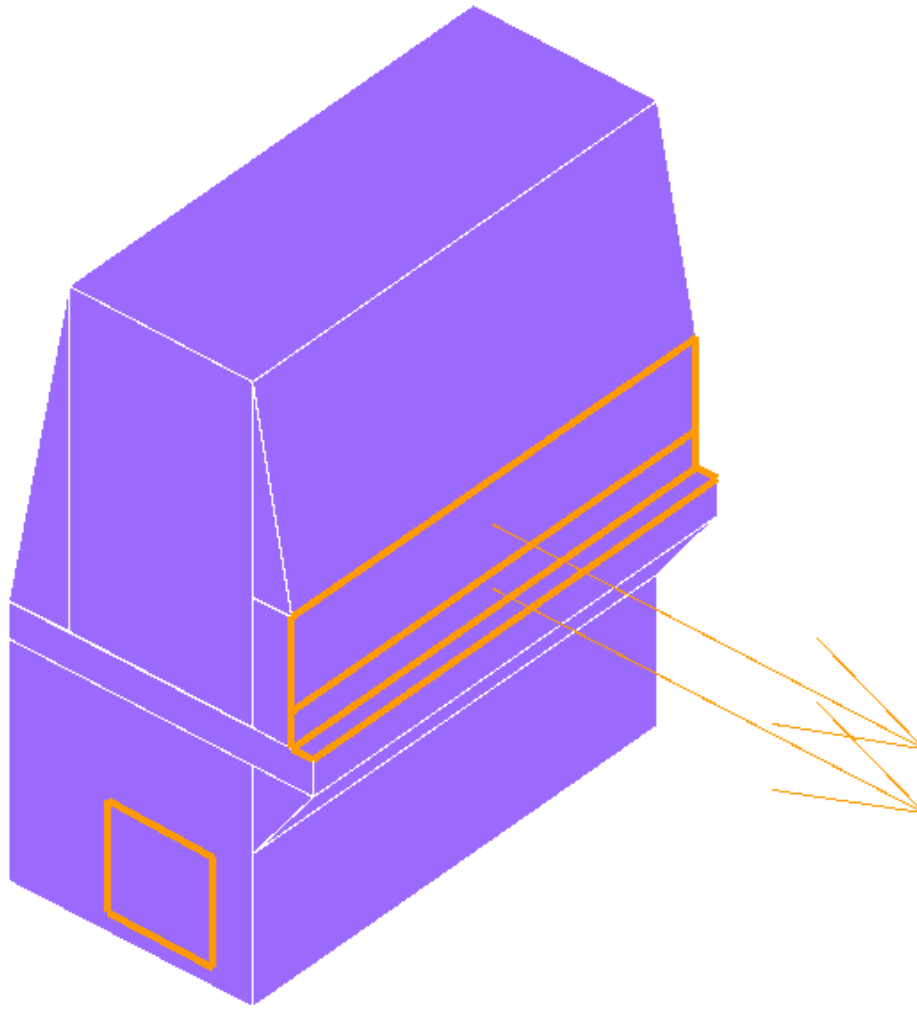


Figure 1.03 *Original Change Station Design*

Due to concerns raised over the relative passiveness of the first station design, a second design was considered, as is displayed in figure 1.04. The station had overall dimensions of 1.50m (59") x 0.86m (34") x 1.93m (76") high. This station also recirculated air, at 300 cfm ($1.42\text{e-}1 \text{ m}^3/\text{s}$), but discharged a much higher percentage than the first design. In particular, 200 cfm ($9.44\text{e-}2 \text{ m}^3/\text{s}$) was discharged through grilles at the top of the station. The air makeup to compensate for this discharge was mounted at the front sill at the opening to the station. The station dissipated 660W, and this heat was considered to be added to the air discharge at the top of the station.

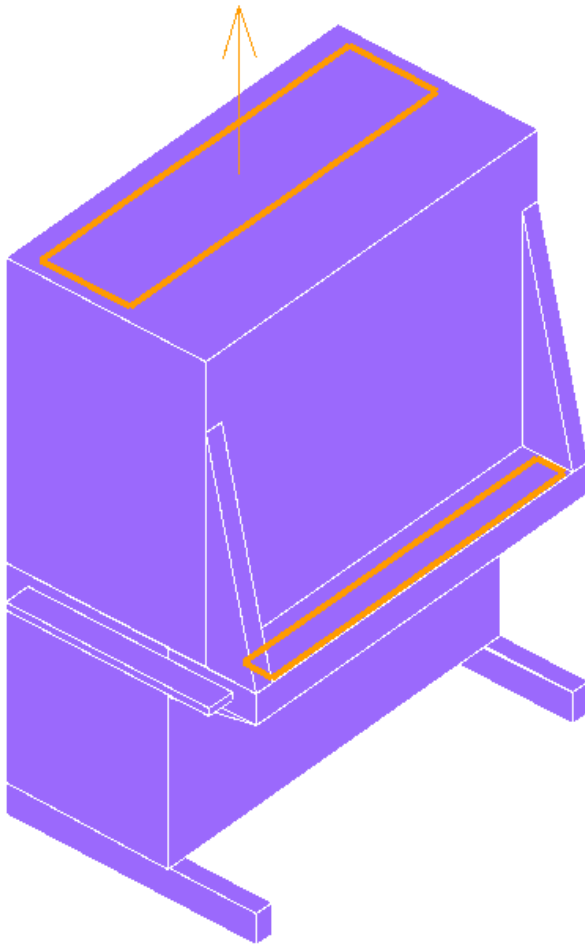


Figure 1.04 *Alternative Change Station Design*

Modeling Assumptions

Solar load was not modeled through the walls of the room.

The floor, ceiling, and walls were assumed to have no heat transfer, i.e., the surrounding areas were assumed to be at the same temperatures.

All surfaces were treated as smooth when calculating surface friction.

The sink in the animal room was modeled as a single rectangular block. The recess formed by the shape of the sink was not modeled because the effect of the recess would be negligible on the overall flow field within the room.

No lighting was assumed in the animal room simulations. The reason for this was that higher CO₂ and NH₃ emissions occur during dark (scotophase) conditions (see volume I, section 4.1.2.8.1 and appendix I, sections 3.4.1.9 and 3.4.1.10).

The animal room was intended to be kept at 22.2 °C (72.0 °F), with temperature control performed on the exhaust air temperature.

No leakage occurred into or out of the animal room other than that specified through the cracks around the door.

Air density variations due to temperature were negligible. Density variation was therefore ignored in all terms apart from in the momentum term for the vertical velocity component. This is known as the Boussinesq approximation.

The levels of CO₂ and NH₃ were so diluted in the whole room simulations, even at their source, that the variation of the mixture density due to differing molecular weights was negligible.

1.2 Whole Room Configurations

To investigate a range of parameters, the basic model described in section 1.1 was modified. Wherever possible, only one parameter was varied at a time to fully assess the effect.

The list of room runs as they were considered is given in table 1.01. Parameters considered in this report are as follows:

Supply Diffuser Type: Three different diffuser types were considered in this project: radial diffusers, low induction diffusers, and slot diffusers. While all these diffuser types are ceiling mounted diffusers, the flow patterns resulting from them are fundamentally different. See volume I, section 4.2.2 and figures 1.05 to 1.07).

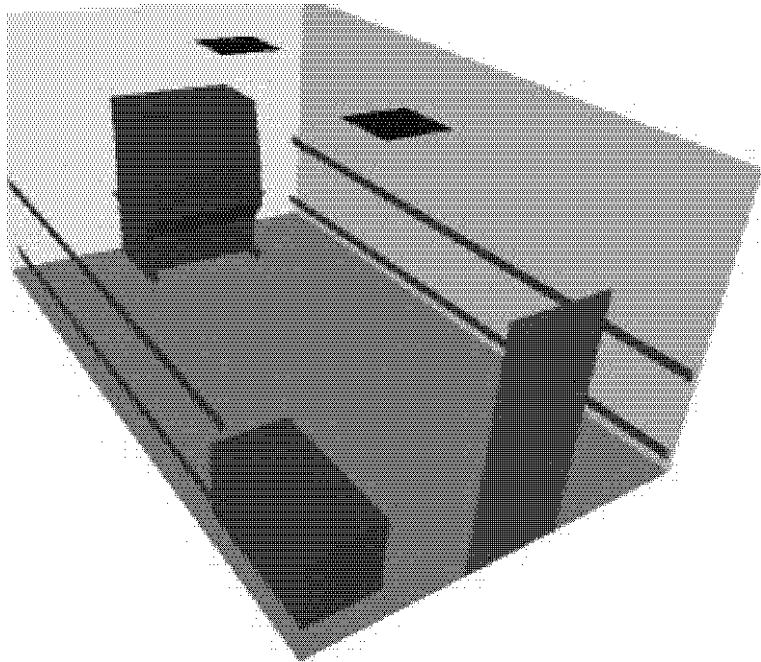


Figure 1.05 Radial Diffuser

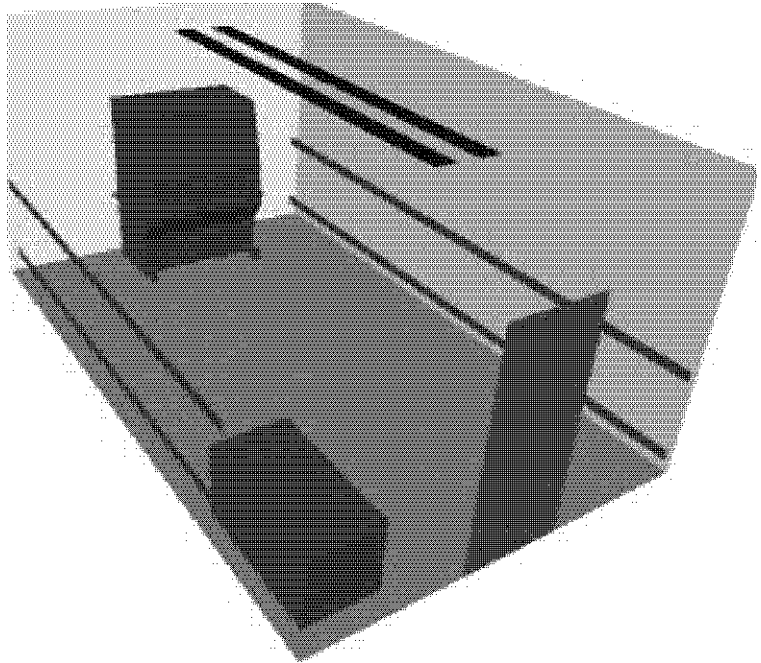


Figure 1.06 Slot Diffuser

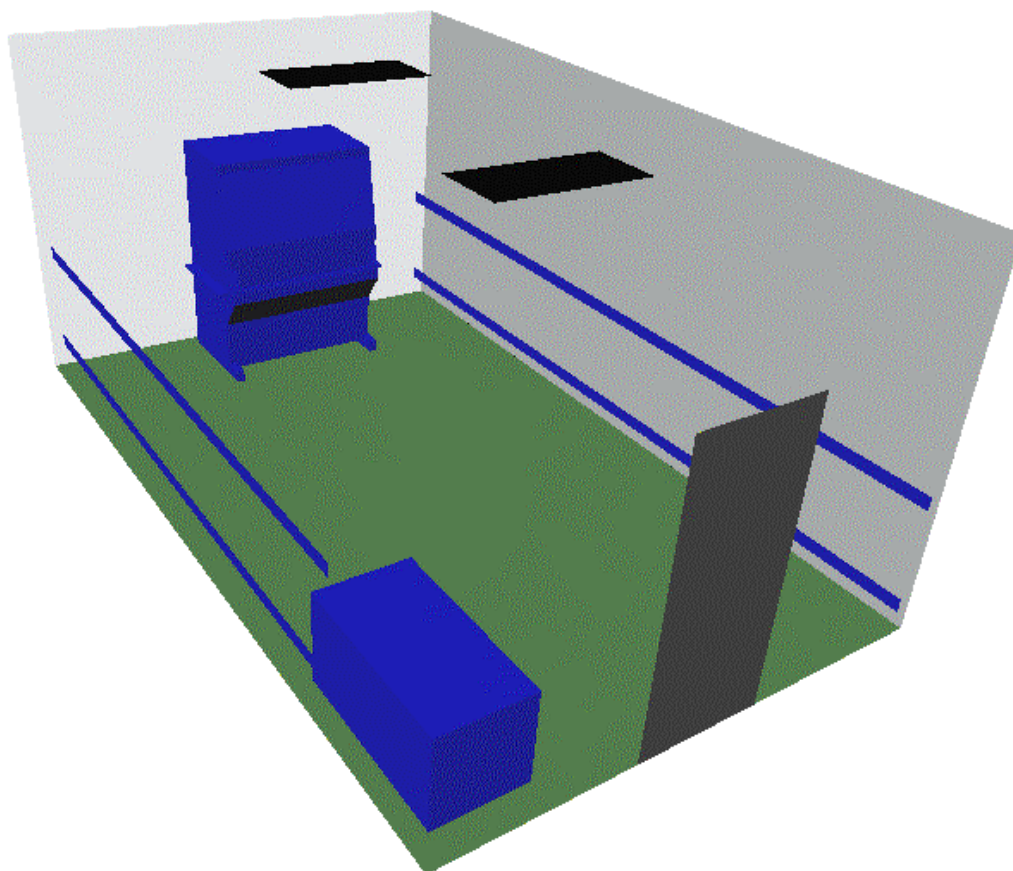


Figure 1.07 *Low Induction Diffuser*

Exhaust Location and Number: Four different exhaust locations were considered: ceiling; high level, low level on the long walls, and low level on the door wall. The number of exhausts used in each of these locations was also considered as a parameter. See figures 1.08 to 1.11.

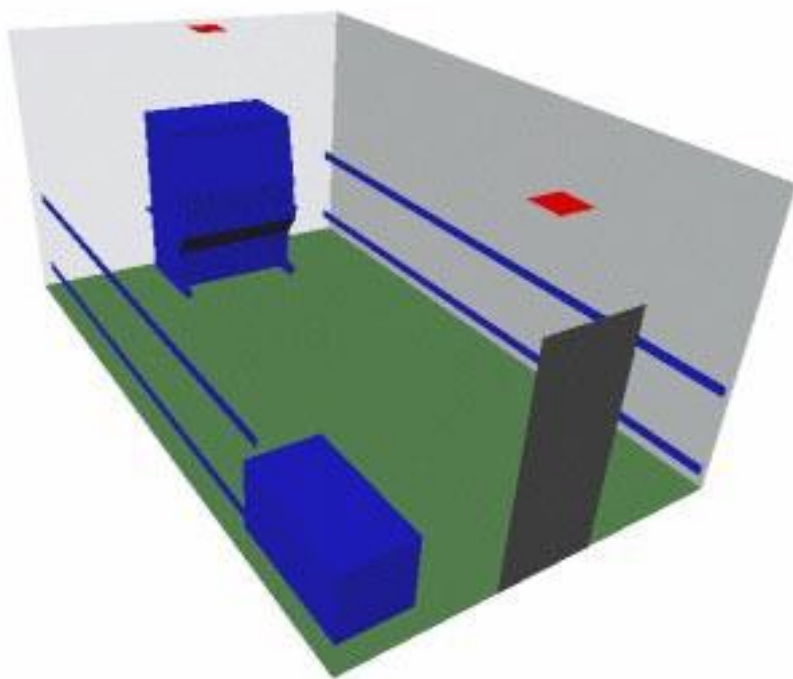


Figure 1.08 Ceiling Level Exhausts

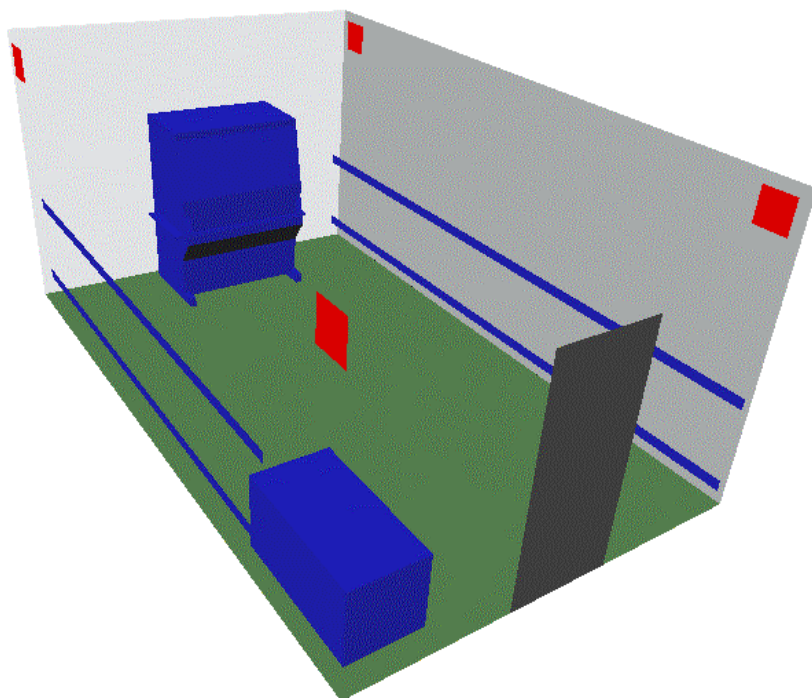


Figure 1.09 High Level Exhausts

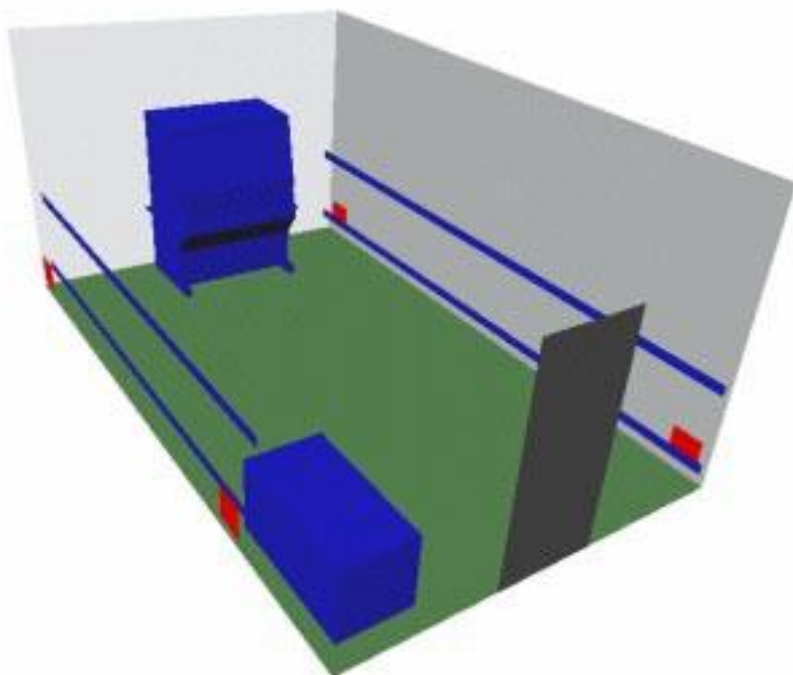


Figure 1.10 Low Level Exhausts

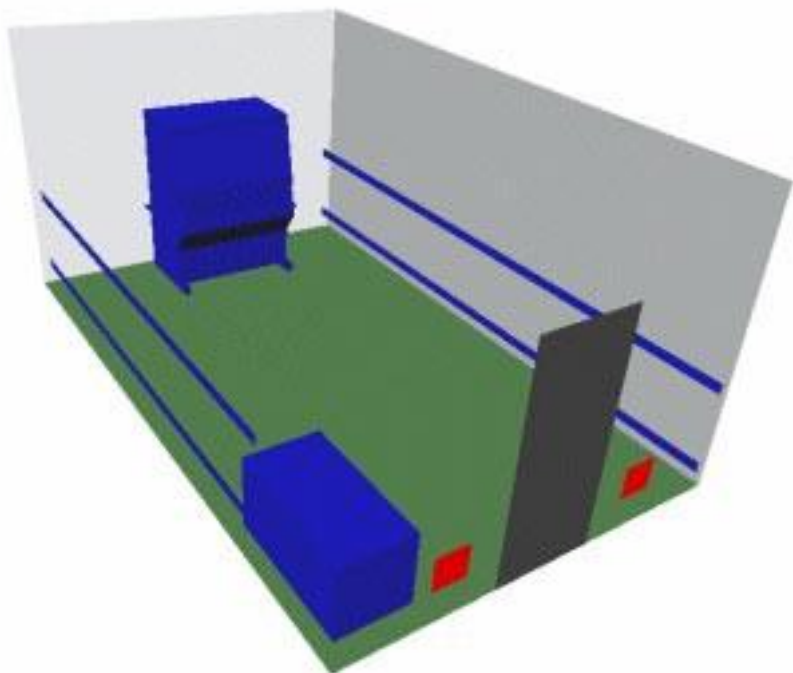


Figure 1.11 Low Level Exhausts on the Door Wall

Room Air Change Rate: In addition to the basecase ACH of 15, the following three other ACH values were considered: 5, 10, and 20 ACH.

Change Station Design and Status: Two different change station designs were considered, as outlined above. The two designs were intended to present both a passive and intrusive influence on the room volume. In the case of the former design, the station was also considered switched off.

Pressurization of Room Relative to Corridor: The pressurization of a room is dependent on the difference between the supply and exhaust flow rates. A higher exhaust rate than supply leads to negative pressurization of the room; hence, makeup air is supplied to the room via available transfer mechanisms, namely door cracks. In this project, the amount of makeup air allowed through the door cracks was varied between 100 cfm ($4.72\text{e-}1 \text{ m}^3/\text{s}$) into the room to 100 cfm ($4.72\text{e-}1 \text{ m}^3/\text{s}$) out of the room.

Orientation of Cage Racks in Room: The racks were considered both parallel to the long walls, and perpendicular to them. See figures 1.12 and 1.13

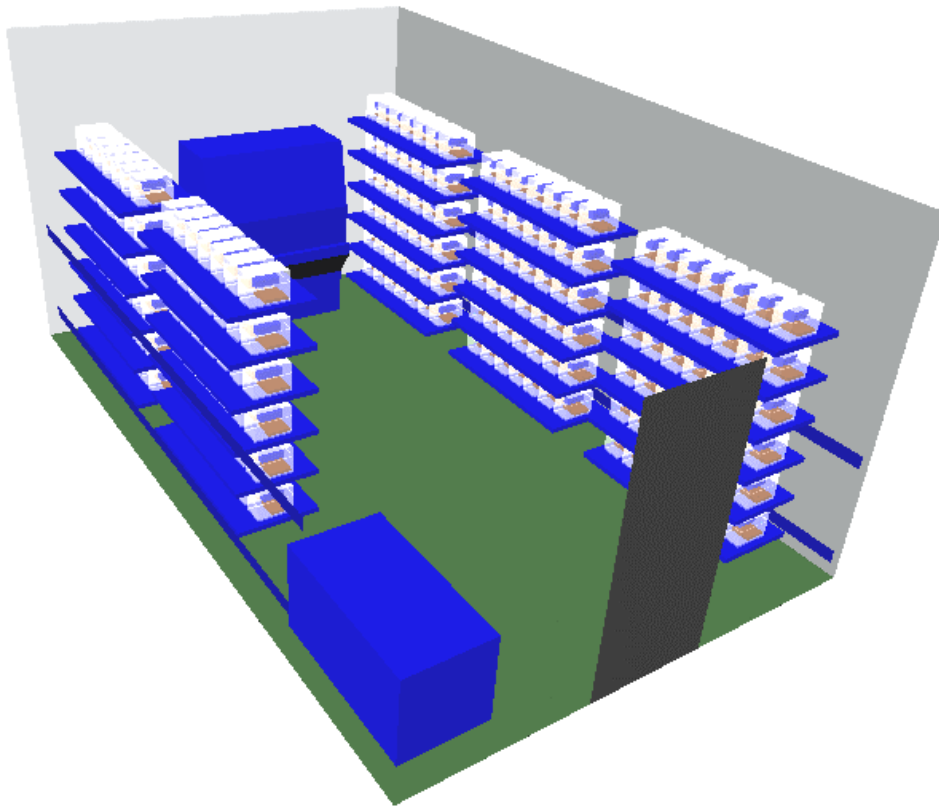


Figure 1.12 Racks Parallel to Side Walls

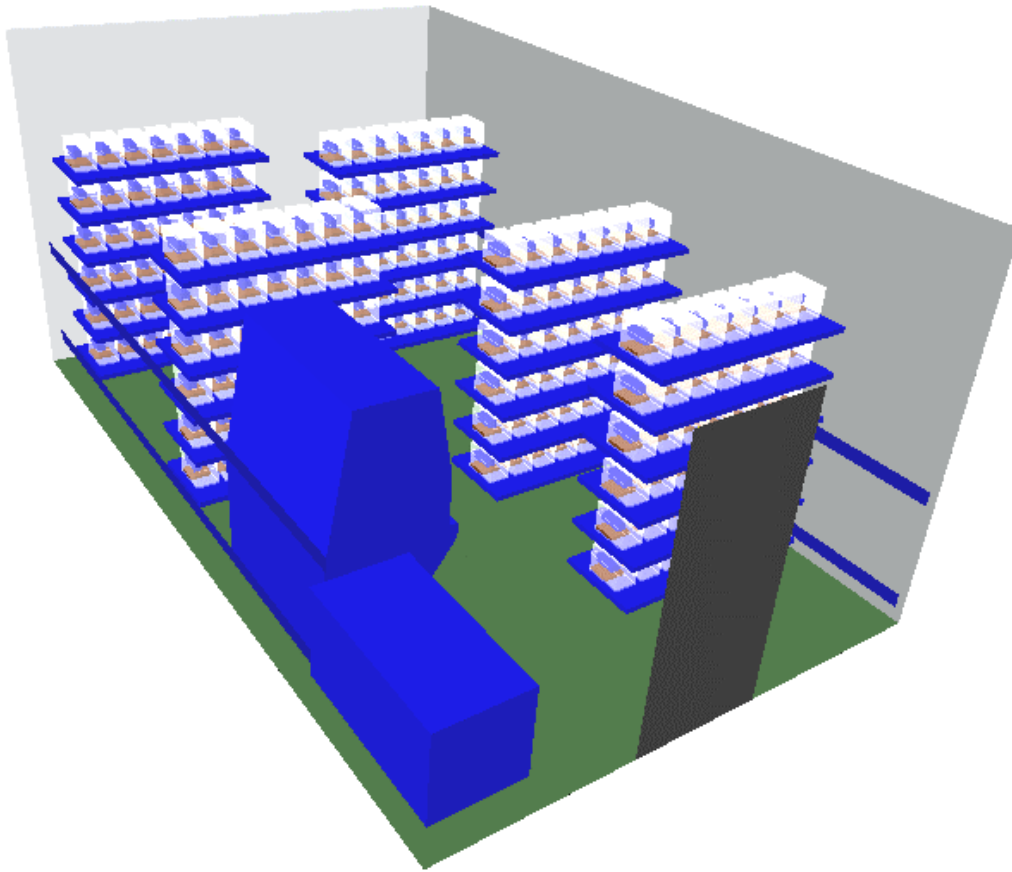


Figure 1.13 Racks Perpendicular to Side Walls

Side Cracks of Cage Sealed Instead of Open: A series of cases was considered in which the side cracks of the cage were sealed, leaving the cage filter top as the only transfer mechanism. The main objective was to establish the relative increase in cage NH_3 and CO_2 levels when the secondary transfer mechanism was removed.

Density of Cages: The number of cages per rack was considered as a parameter. In addition to the basecase value of 42 cages per rack, a double density 84 cages per rack was also considered, as was a reduced density of 28 cages per rack. See figures 1.14 and 1.15.



Figure 1.14 Double Density Rack

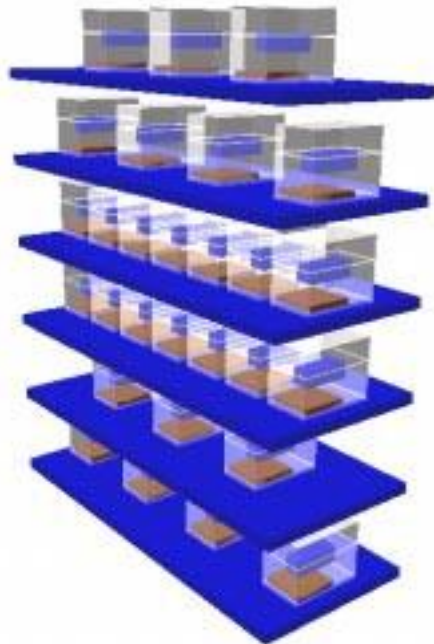


Figure 1.15 Reduced Density Rack

Location of Change Station: The location of the change station was swapped with each of the racks in the room. See figures 1.16 to 1.20.

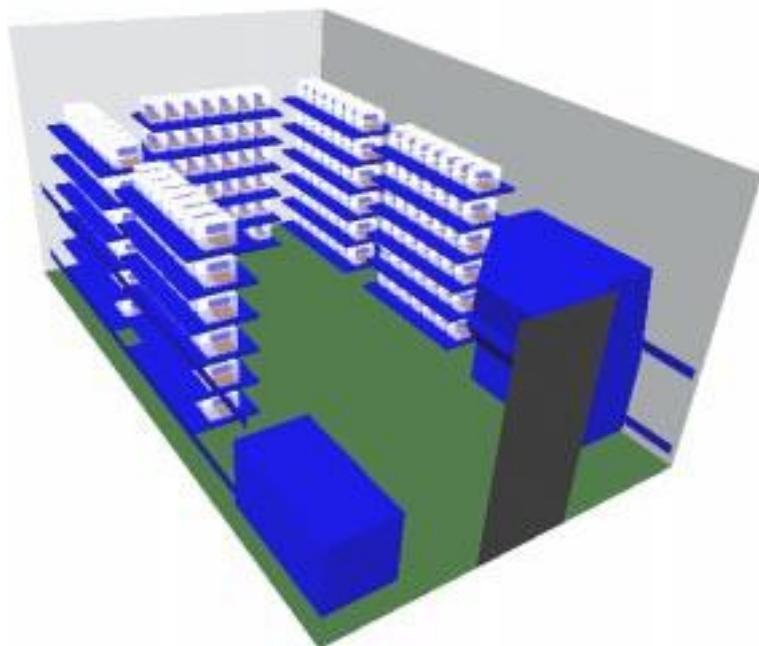


Figure 1.16 Change Station Swapped with Rack 1

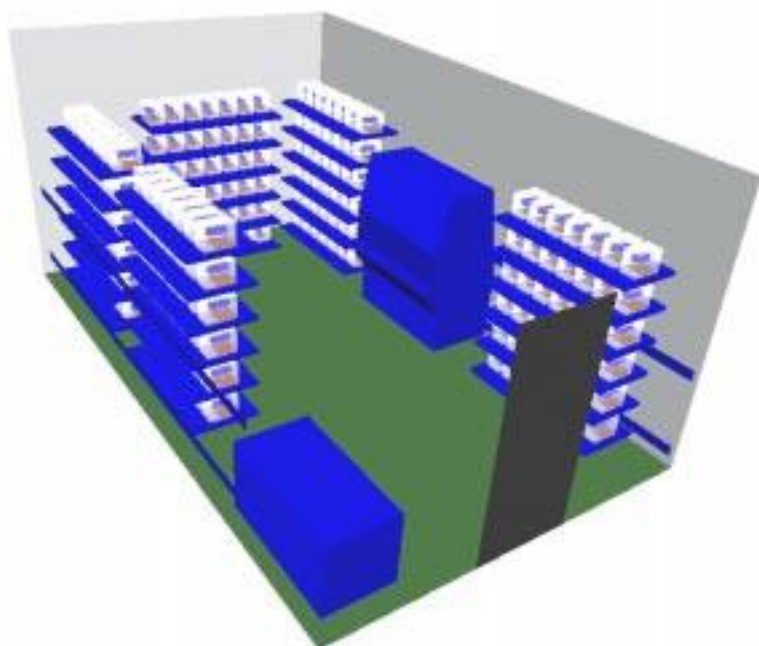


Figure 1.17 Change Station Swapped with Rack 2

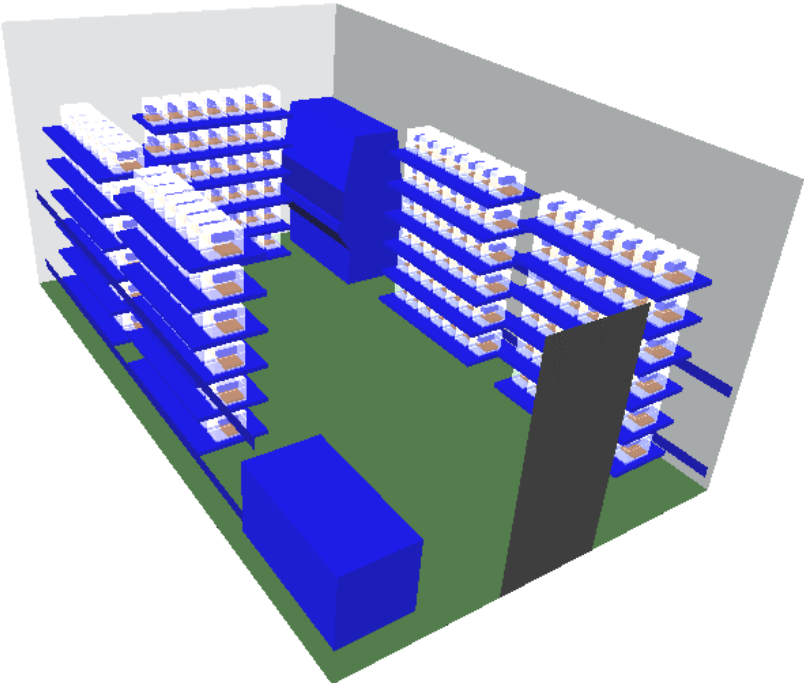


Figure 1.18 Change Station Swapped with Rack 3

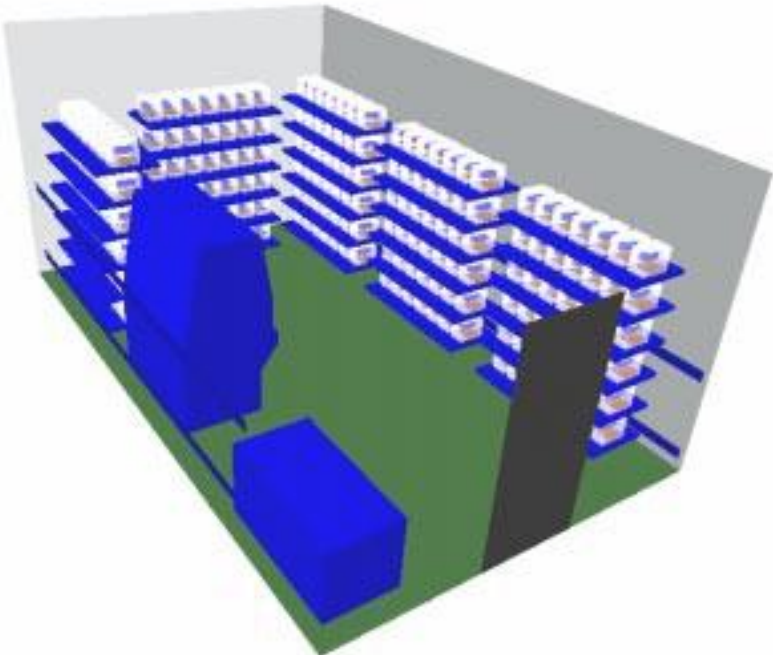


Figure 1.19 Change Station Swapped with Rack 4

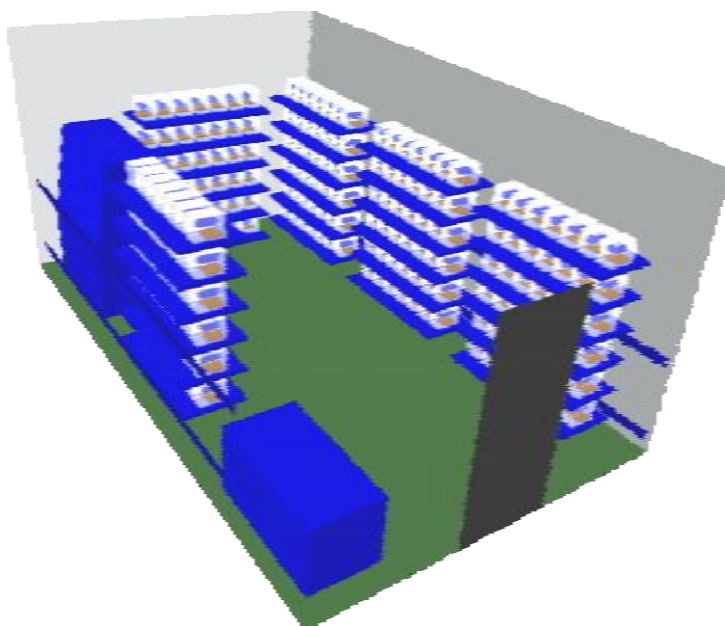


Figure 1.20 Change Station swapped with Rack 5

Rack Grouping: In some series, the racks were considered to be along one wall only, rather than spread out through the room. See figure 1.21.

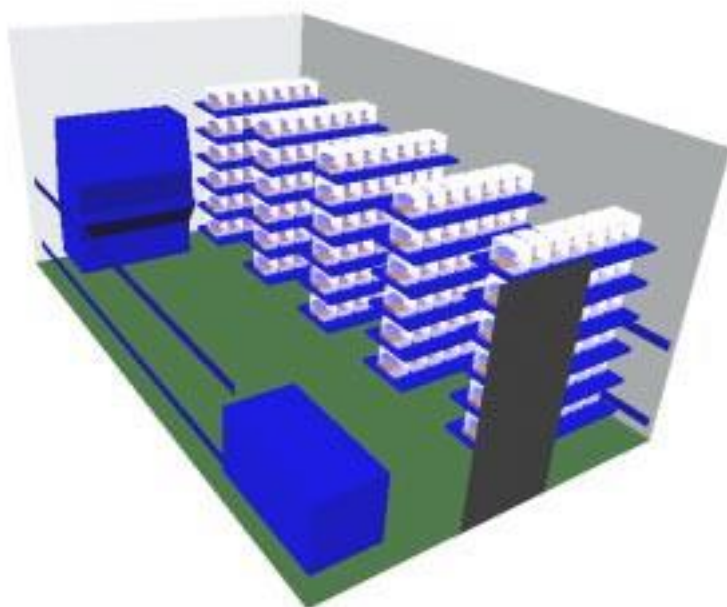


Figure 1.21 Racks on One Wall Only

Room Width: Three runs were performed with the room width increased to 4.26m (14' 0").

- *Supply Air Temperature:* In a few runs the supply air temperature was raised to 22.2 °C (72.0 °F), at 49 percent RH which would cause the room and exhaust temperatures to be higher than the design value of the baseline case.

Case Name	Supply Diffuser Type	Exhaust Location and Number	Change Station (Design/ Status)	Rack orientation	Rack density	Pressure of Room to Corridor	Supply Temperature °C (°F)	Supply ACH
Case 70	Slot	High (x4) / Low (x4) (Mass flow split evenly amongst exhausts)	Thoren/ ON	Parallel	Single	Neg. 100cfm	18.8 (65.8)	15
Case 71	Low Ind	High (x4) / Low (x4) (Mass flow split evenly amongst exhausts)	Thoren/ ON	Parallel	Single	Neg. 100cfm	18.8 (65.8)	15
Case 72	Radial	High (x4) / Low (x2) (Mass flow split evenly amongst exhausts)	Thoren/ ON	Parallel	Single	Neg. 100cfm	18.8 (65.8)	15
Case 73	Slot	High (x4) / Low (x2) (Mass flow split evenly amongst exhausts)	Thoren/ ON	Parallel	Single	Neg. 100cfm	18.8 (65.8)	15
Case 74	Low Ind	High (x4) / Low (x2) (Mass flow split evenly amongst exhausts)	Thoren/ ON	Parallel	Single	Neg. 100cfm	18.8 (65.8)	15
Case 75	Radial	Ceiling (x1) / Low (x4) (Mass flow in 50/50 split)	Lab. Prod. / ON	Parallel	Single	Neg. 100cfm	18.8 (65.8)	15
Case 76 **	Radial	Ceiling (x2)	Thoren/ ON	Parallel	Single	Neg. 100cfm	19.2 (66.6)	15
Case 77 **	Slot	Ceiling (x2)	Thoren/ ON	Parallel	Single	Neg. 100cfm	19.2 (66.5)	15
Case 78 **	Low Ind	Ceiling (x2)	Thoren/ ON	Parallel	Single	Neg. 100cfm	19.2 (66.6)	15
Case 79	Radial	2 Door exhausts	Thoren/ ON	Parallel	Single	Neg. 100cfm	18.8 (65.8)	15
Case 80	Slot	2 Door exhausts	Thoren/ ON	Parallel	Single	Neg. 100cfm	18.8 (65.8)	15
Case 81	Low Ind	2 Door exhausts	Thoren/ ON	Parallel	Single	Neg. 100cfm	18.8 (65.8)	15
Case 82	Radial	2 Door exhausts	Thoren/ ON	Parallel	Single	Neg. 100cfm	18.8 (65.8)	15
Case 83	Slot	2 Door exhausts	Thoren/ ON	Perpendicular	Double	Neg. 100cfm	17.5 (63.5)	15
Case 84	Low Ind	2 Door exhausts	Thoren/ ON	Perpendicular	Double	Neg. 100cfm	17.5 (63.5)	15
Case 85	Radial	Low (x4)	Lab. Prod. / ON	Perpendicular	Double	Neg. 100cfm	17.5 (63.5)	15
Case 86	Slot	Low (x4)	Lab. Prod. / ON	Perpendicular	Double	Neg. 100cfm	17.5 (63.5)	15
Case 87	Radial	Low (x4)	Thoren/ ON	Parallel	Reduced	Neg. 100cfm	19.2 (66.6)	15
Case 88	Slot	Low (x4)	Thoren/ ON	Parallel	Reduced	Neg. 100cfm	19.2 (66.6)	15
Case 89	Low Ind	Low (x4)	Thoren/ ON	Parallel	Reduced	Neg. 100cfm	19.2 (66.6)	15
Case 90	Radial	Ceiling (x2)	Thoren/ ON	Perpendicular all 5 on 1 wall	Single	Neg. 100cfm	18.8 (65.8)	15
Case 91	Slot	Ceiling (x2)	Thoren/ ON	Perpendicular all 5 on 1 wall	Single	Neg. 100cfm	18.8 (65.8)	15
Case 92	Low Ind	Ceiling (x2)	Thoren/ ON	Perpendicular all 5 on 1 wall	Single	Neg. 100cfm	18.8 (65.8)	15

Case Name	Supply Diffuser Type	Exhaust Location and Number	Change Station (Design/Status)	Rack orientation	Rack density	Pressure of Room to Corridor	Supply Temperature °C (°F)	Supply ACH
Case 93	Radial	Ceiling (x2)	Thoren/ ON	Perpendicular all 5 on 1 wall	Double	Neg. 100cfm	17.5 (63.5)	15
Case 94	Slot	Ceiling (x2)	Thoren/ ON	Perpendicular all 5 on 1 wall	Double	Neg. 100cfm	17.5 (63.5)	15
Case 95	Low Ind	Ceiling (x2)	Thoren/ ON	Perpendicular all 5 on 1 wall	Double	Neg. 100cfm	17.5 (63.5)	15
Case 96	Radial	Ceiling (x2)	Lab. Prod. / ON	Perpendicular all 5 on 1 wall	Double	Neg. 100cfm	17.5 (63.5)	15
Case 97	Slot	Ceiling (x2)	Lab. Prod. / ON	Perpendicular all 5 on 1 wall	Double	Neg. 100cfm	17.5 (63.5)	15
Case 98	Low Ind	Ceiling (x2)	Lab. Prod. / ON	Perpendicular all 5 on 1 wall	Double	Neg. 100cfm	17.5 (63.5)	15
Case 99 ***	Radial	Ceiling (x2)	Thoren/ ON	Parallel	Single	Neg. 100cfm	22.2 (72.0)	15
Case 100 ***	Radial	Low (x4)	Thoren/ ON	Parallel	Single	Neg. 100cfm	22.2 (72.0)	15
Case 101 ***	Low Ind	Low (x4)	Lab. Prod. / ON	Perpendicular	Double	Neg. 100cfm	22.2 (72.0)	5

* Sealed cages instead of open cages

** Room 4.26m (14' 0") wide instead of 3.66m (12' 0")

*** Supply air temperature fixed at 22.2 °C (72.0 °F). In all other cases, the exhaust temperature was set to be 22.2 °C (72.0 °F) by setting the supply air temperature appropriately.

Table 1.02 Cases Cross-Referenced Against Supply Diffuser Type

Supply Diffuser Type	Case Number
Radial	Basecase, 02-03, 10-11, 16, 19, 22, 25, 31, 34, 37, 40, 44*, 45-53, 56-57, 69, 72, 75-76, 79, 82, 85, 87, 90, 93, 96, 99-100
Slot	04-06, 12-13, 17, 20, 23, 26, 32, 35, 38, 41, 54, 58-59, 70, 73, 77, 80, 83, 86, 88, 91, 94, 97
Low Induction	07-09, 14-15, 18, 21, 24, 27-30, 33, 36, 39, 42, 43*, 55, 60-68, 71, 74, 78, 81, 84, 89, 92, 95, 98, 101

* Indicates that diffuser rotated by 90°

Table 1.03 Cases Cross-Referenced Against Exhaust Location and Number

Exhaust Location and Number	Case Number
Ceiling (x2)	Basecase, 04, 07, 10, 12, 14, 16-21, 25-27, 34-36, 43-55, 76-78, 90-99
High (x4)	02, 05, 08, 56, 58, 60
Low (x4)	03, 06, 09, 11, 13, 15, 22-24, 28-33, 57, 59, 61-68, 85-89, 100-101
Ceiling (x1) / Low (x4) (Mass flow in 50/50 split)	37-39, 75
Ceiling (x4)	40-42
High (x4)/ Low (x4) (Mass flow split evenly amongst exhausts)	69-71
High (x4)/ Low (x2) (Mass flow split evenly amongst exhausts)	72-74
2 Door Exhausts	79-84

Table 1.04 Cases Cross-Referenced Against Change Station Design and Status

Change Station	Case Number
ON*	Basecase – 09, 16-101
OFF*	10-15
Thoren Design	Basecase –52**, 62-64, 69-74, 76-84, 87-95, 99-100
Laboratory Products Design	53-61, 65-68, 75, 85-86, 96-98, 101

*Change in status was only considered for Thoren design change station.

**Cases 10 to 15 had Thoren design change station switched off.

Table 1.05 Cases Cross-Referenced Against Pressurization of Room Relative to Corridor

Pressurization of Room to Corridor	Case Number
Neg. 100 cfm	basecase –15, 19-44, 48-101
Pos. 100 cfm	16-18
Neg. 50cfm	45
Neutral	46
Pos. 50 cfm	47

Table 1.06 Cases Cross-Referenced Against Pressurization of Room Relative to Corridor

Rack Orientation	Case Number
Parallel	basecase – 18, 25-30, 37-61***, 69-82, 87-89, 99-100
Perpendicular	19-24, 31-36, 62-68, 83-86,101
Perpendicular All 5 on 1 Wall	90-98

*** Cases 48 to 52 had change station swapped with each of five racks.

Table 1.07 Cases Cross-Referenced Against Status of Cage Side Cracks

Status of Cage Side Cracks	Case Number
Open	basecase – 24, 28-101
Sealed	25-27

Table 1.08 Cases Cross-Referenced Against Density of Cages in Rack

Density of Cages in Rack	Case Number
Single	basecase – 30, 37-61, 69-82, 90-92, 99-100
Double	31-36, 62-68, 83-86, 93-98, 101
Reduced	87-89

Table 1.09 Cases Cross-Referenced Against Room Air Change Rate

Room Air Change Rate (ACH)	Case Number
5	29, 62, 66, 101
10	28, 63, 67
15	basecase – 27, 31-61, 65, 69-100
20	30, 64, 68

Table 1.10 Cases Cross-referenced Against Room Width

Room Width (ft)	Case Number
12	basecase -75, 79-101
14	76-78

Table 1.11 Cases Cross-Referenced Against Supply Temperature (1)

Supply Temperature	Case Number
Supply Temperature set such that air is at 22.22°C (72°F) at Exhaust	basecase – 98
22.22°C	99-101

Table 1.12 Cases Cross-Referenced Against Supply Temperature (2)

Supply Temperature	Case Number
6.60	62, 66
11.00	29
14.80	63, 67
16.80	28
17.50	31-36, 65, 83-86,93-98
18.80	basecase – 09, 16-27, 37-61, 69-75, 79-82, 90-92
18.90	64, 68
19.20	76-78, 87-89
19.80	30
20.70	10-15
22.22****	99-101

**** In these cases, the supply air temperature was set to 22.22 °C (72 °F). In all other cases, the exhaust air temperature was set to be 22.22 °C (72 °F) by setting the supply air temperature appropriately.

2. SUMMARY OF RESULTS OF WHOLE ROOM RUNS

Discussion of these figures and tables can be found in volume I, section 3.1.

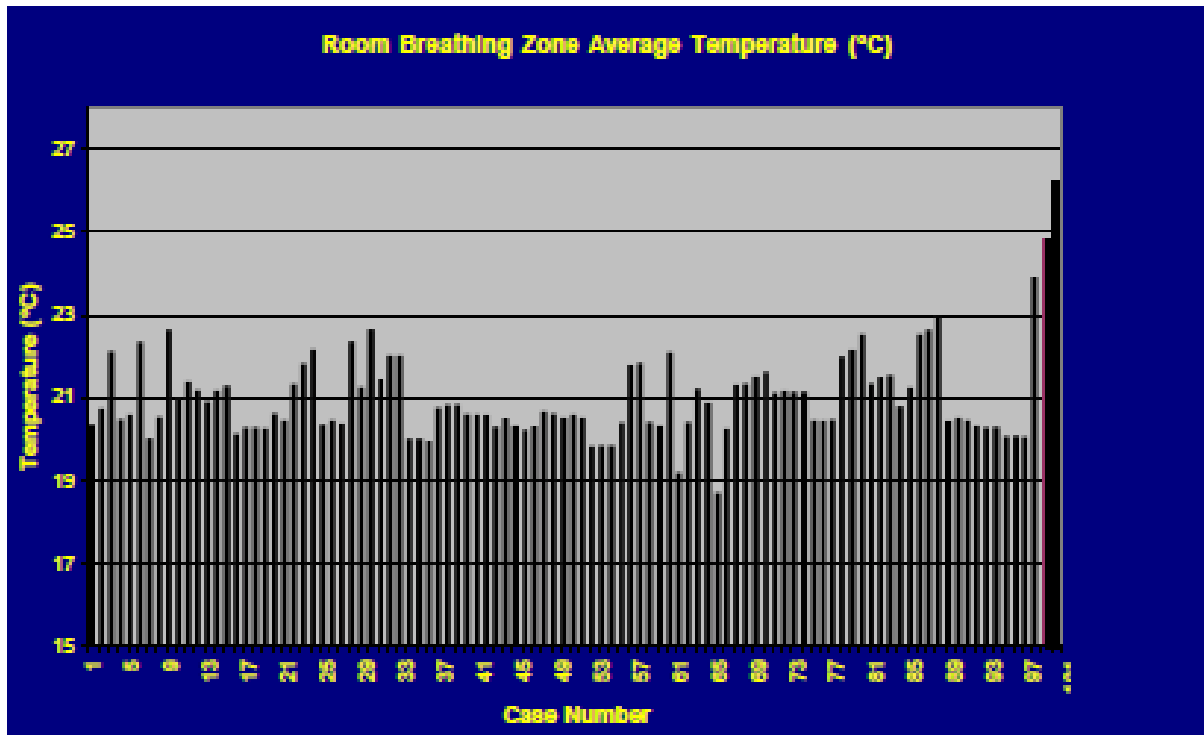


Figure 2.01 Mean Room Breathing Zone Temperature

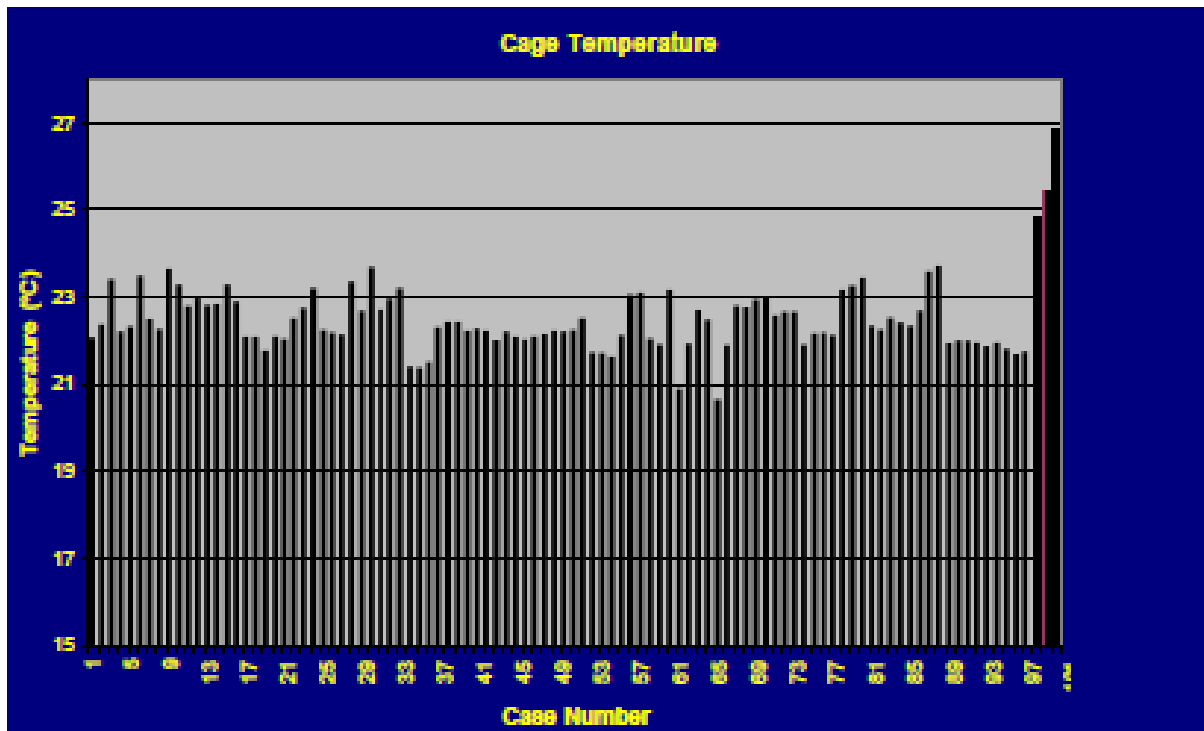


Figure 2.02 Mean Cage Temperatures

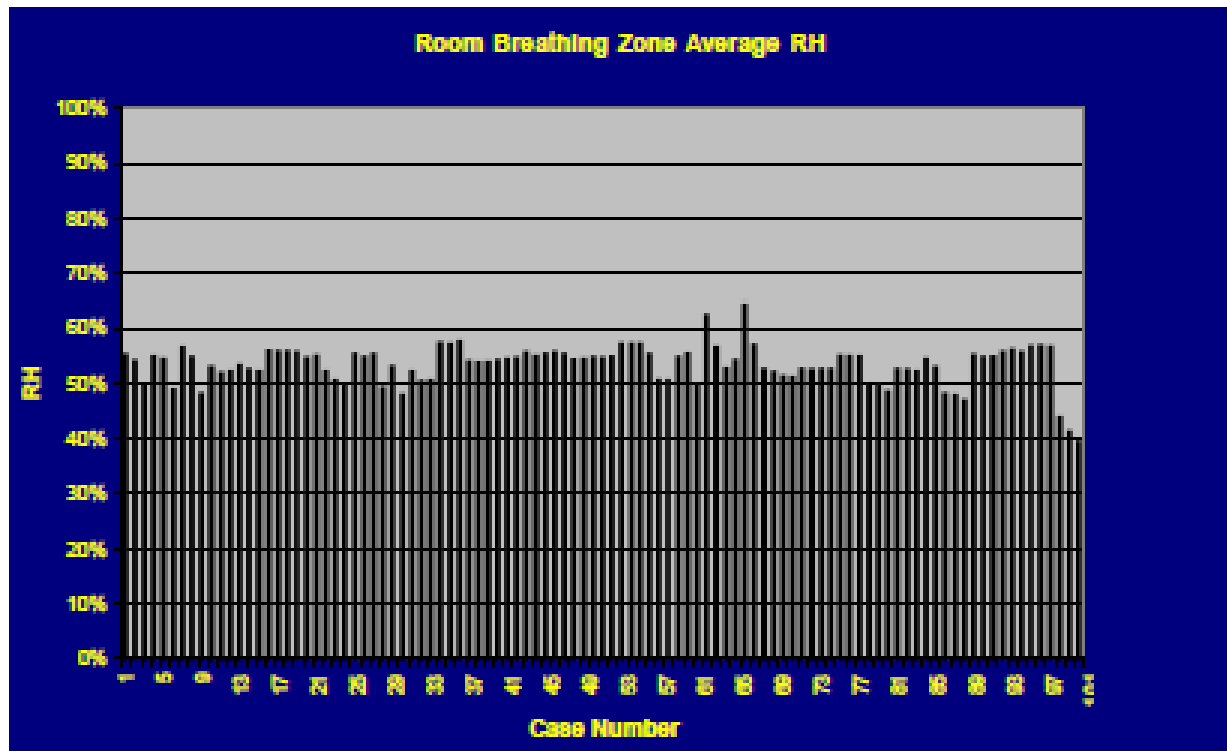


Figure 2.03 Mean Room Breathing Zone Relative Humidity (RH)

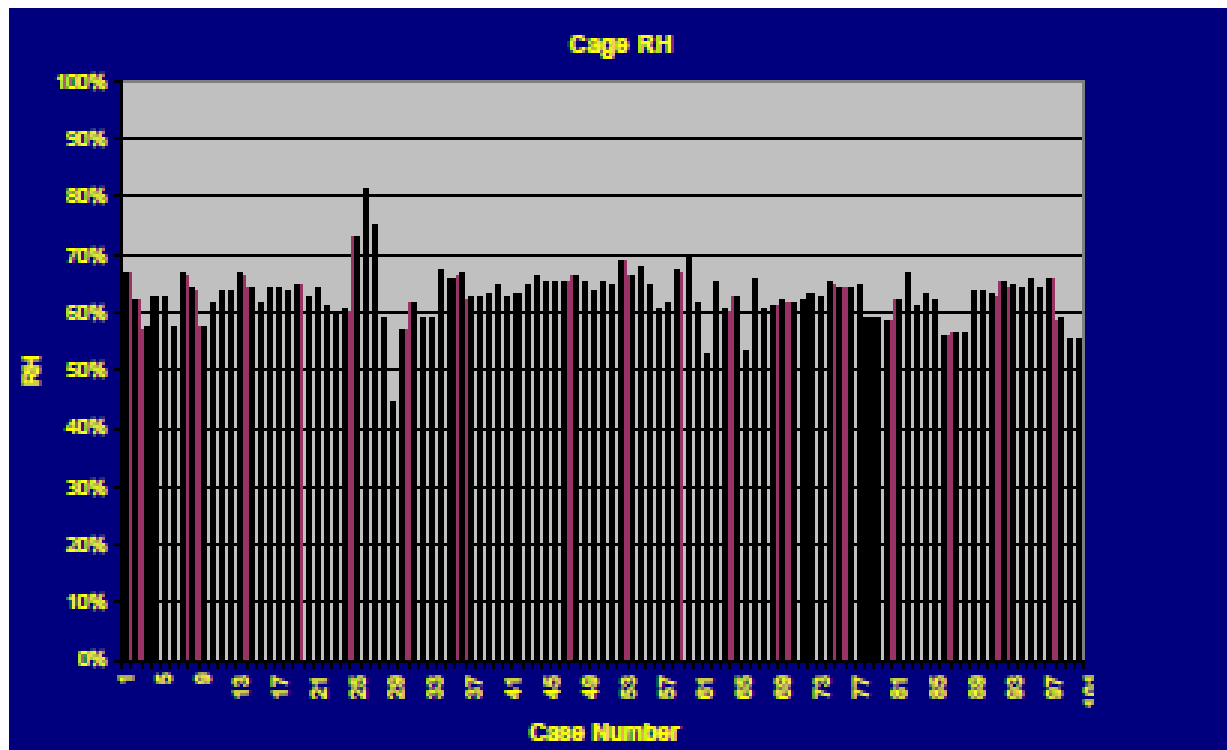


Figure 2.04 Mean Cage Relative Humidity (RH)

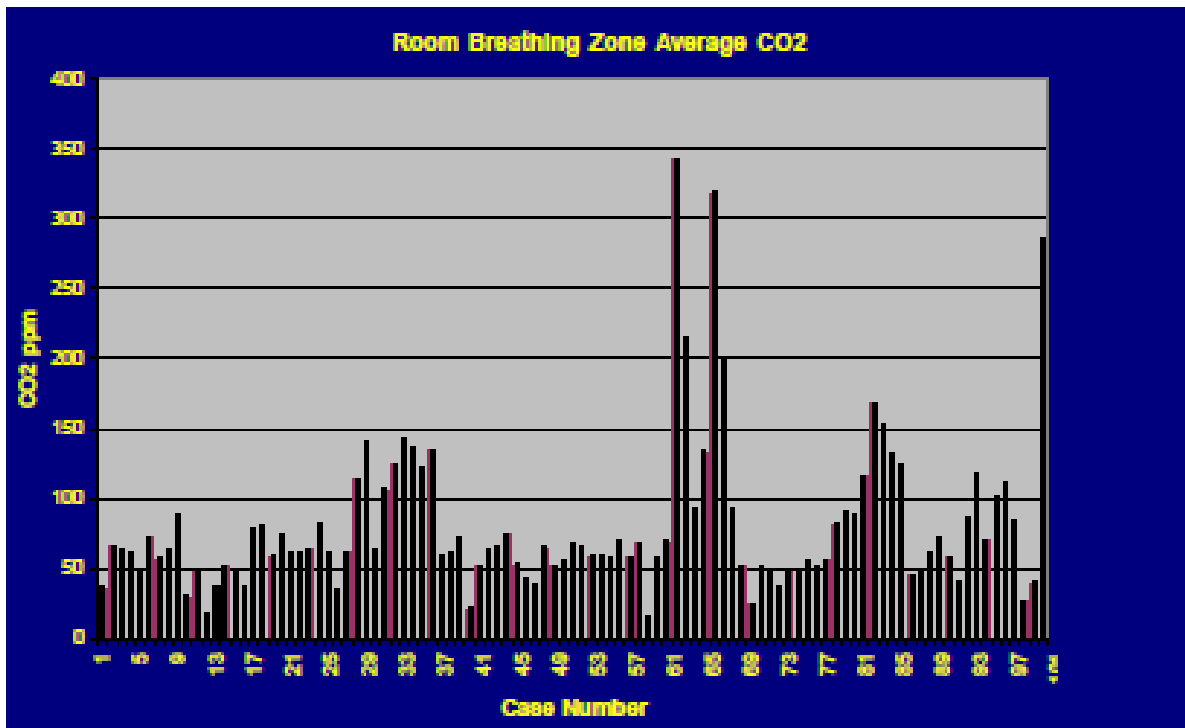


Figure 2.05 Mean Room Breathing Zone CO₂ Concentration

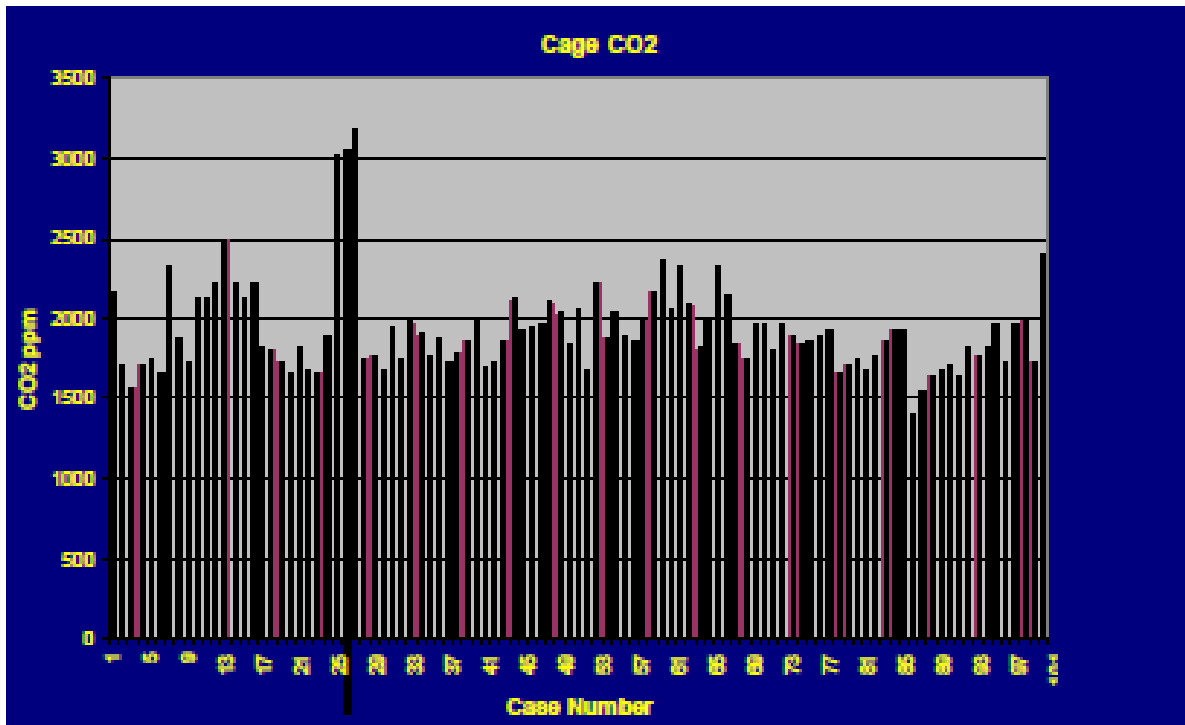


Figure 2.06 Mean Cage CO₂ Concentrations

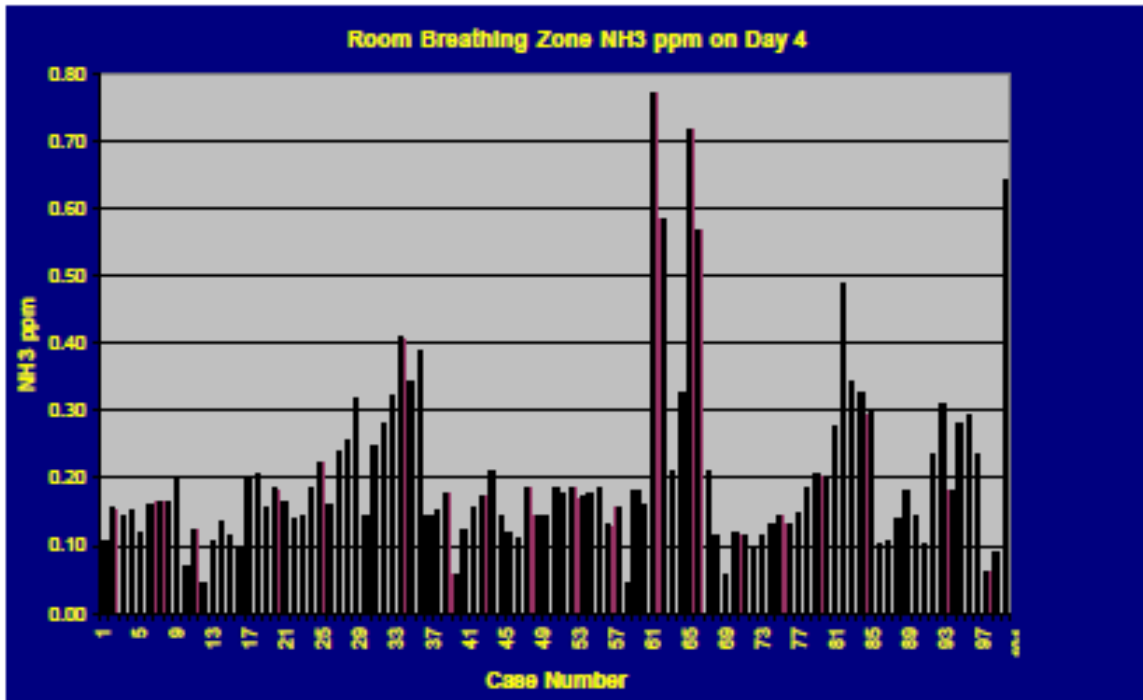


Figure 2.07 Mean Room Breathing Zone NH₃ Concentration on Day 4

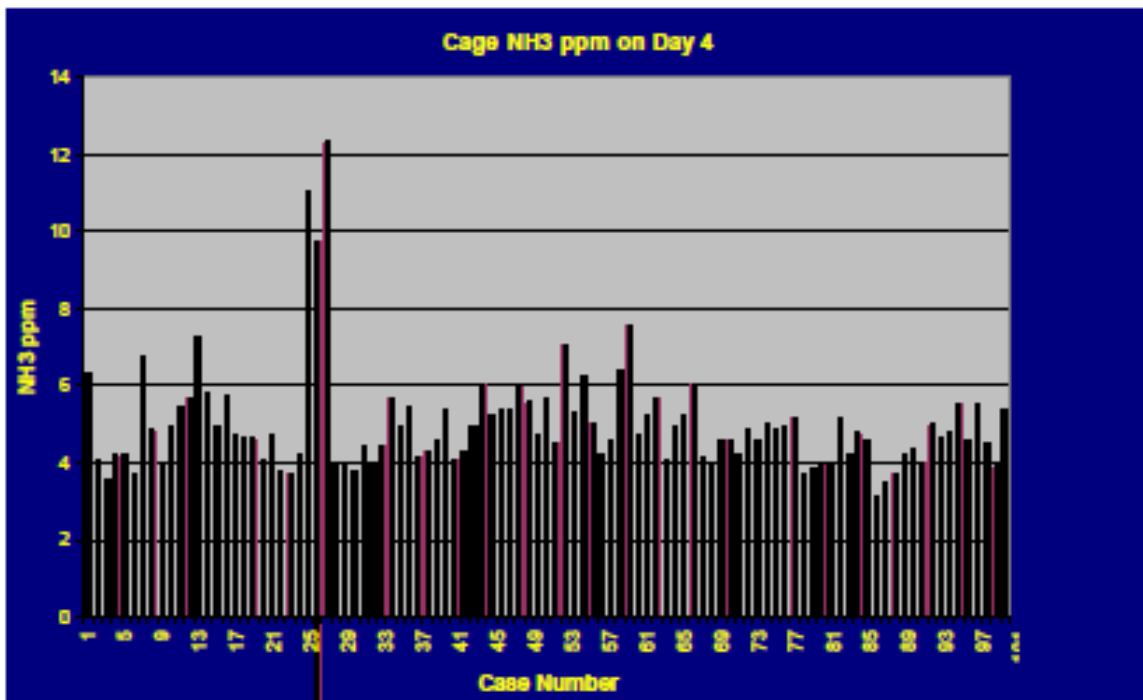


Figure 2.08 Mean Cage NH₃ Concentration on Day 4

3. RANKINGS OF RESULTS OF WHOLE ROOM RUNS

3.1 Introduction

The following tables present rankings of the results of the CFD room simulations based on Room (scientists' breathing zone) and cages mean values for CO₂ and NH₃ (day 4) concentrations, temperature, and relative humidity. The tables start with the case with the lowest value and list the rest in ascending order. The case number should be used to identify all details of the case. The supply diffuser type, exhaust location, supply flow rate, and supply discharge temperature are given to provide a quick overview of the case.

Discussion of these tables can be found in volume I, section 3.3.

Table 3.01 Ranking of Cases with respect to Room Temperature

Case Name	Supply Diffuser Type	Exhaust Location and Number	Supply ACH	Supply Temperature (°C)	Supply Temperature (°F)	Room Temp (°C)	Room Temp (°F)
Case 66	Low Ind	Low	5	6.6	43.9	18.6	65.6
Case 62	Low Ind	Low	5	6.6	43.9	19.1	66.5
Case 53	Radial	Ceiling	15	18.8	65.8	19.8	67.6
Case 55	Low Ind	Ceiling	15	18.8	65.8	19.8	67.6
Case 54	Slot	Ceiling	15	18.8	65.8	19.8	67.6
Case 36	Low Ind	Ceiling	15	17.5	63.5	19.9	67.8
Case 35	Slot	Ceiling	15	17.5	63.5	20.0	67.9
Case 34	Radial	Ceiling	15	17.5	63.5	20.0	67.9
Case 07	Low Ind	Ceiling	15	18.8	65.8	20.0	67.9
Case 98	Low ind	Ceiling	15	17.5	63.5	20.0	68.0
Case 96	Radial	Ceiling	15	17.5	63.5	20.0	68.0
Case 97	Slot	Ceiling	15	17.5	63.5	20.0	68.0
Case 16	Radial	Ceiling	15	18.8	65.8	20.1	68.1
Case 46	Radial	Ceiling	15	18.8	65.8	20.2	68.3
Case 67	Low Ind	Low	10	14.8	58.6	20.2	68.3
Case 19	Radial	Ceiling	15	18.8	65.8	20.2	68.4
Case 18	Low Ind	Ceiling	15	18.8	65.8	20.2	68.4
Case 17	Slot	Ceiling	15	18.8	65.8	20.2	68.4
Case 94	Slot	Ceiling	15	17.5	63.5	20.2	68.4
Case 95	Low Ind	Ceiling	15	17.5	63.5	20.2	68.4
Case 43	Low Ind (rot 90°)	Ceiling	15	18.8	65.8	20.2	68.4
Case 47	Radial	Ceiling	15	18.8	65.8	20.3	68.5
Case 93	Radial	Ceiling	15	17.5	63.5	20.3	68.5
Case 45	Radial	Ceiling	15	18.8	65.8	20.3	68.5
Case 60	Low Ind	High	15	18.8	65.8	20.3	68.5
Basecase	Radial	Ceiling	15	18.8	65.8	20.3	68.5
Case 25	Radial	Ceiling	15	18.8	65.8	20.3	68.5
Case 27	Low Ind	Ceiling	15	18.8	65.8	20.3	68.6
Case 56	Radial	High	15	18.8	65.8	20.3	68.6
Case 59	Slot	Low	15	18.8	65.8	20.3	68.6
Case 63	Low Ind	Low	10	14.8	58.6	20.3	68.6
Case 90	Radial	Ceiling	15	18.8	65.8	20.4	68.7
Case 77	Slot	Ceiling	15	18.8	65.8	20.4	68.7
Case 76	Radial	Ceiling	15	18.8	65.8	20.4	68.7
Case 21	Low Ind	Ceiling	15	18.8	65.8	20.4	68.7
Case 92	Low Ind	Ceiling	15	18.8	65.8	20.4	68.7
Case 26	Slot	Ceiling	15	18.8	65.8	20.4	68.7
Case 78	Low Ind	Ceiling	15	18.8	65.8	20.4	68.7
Case 04	Slot	Ceiling	15	18.8	65.8	20.4	68.8
Case 44	Radial (rot 90°)	Ceiling	15	18.8	65.8	20.4	68.8
Case 91	Slot	Ceiling	15	18.8	65.8	20.5	68.8
Case 50	Radial	Ceiling	15	18.8	65.8	20.5	68.8
Case 52	Radial	Ceiling	15	18.8	65.8	20.5	68.8
Case 08	Low Ind	High	15	18.8	65.8	20.5	68.9
Case 42	Low Ind	Ceiling x4	15	18.8	65.8	20.5	68.9
Case 51	Radial	Ceiling	15	18.8	65.8	20.5	69.0
Case 05	Slot	High	15	18.8	65.8	20.5	69.0
Case 41	Slot	Ceiling x4	15	18.8	65.8	20.5	69.0
Case 40	Radial	Ceiling x4	15	18.8	65.8	20.5	69.0
Case 49	Radial	Ceiling	15	18.8	65.8	20.5	69.0
Case 20	Slot	Ceiling	15	18.8	65.8	20.6	69.0
Case 48	Radial	Ceiling	15	18.8	65.8	20.6	69.1
Case 02	Radial	High	15	18.8	65.8	20.7	69.2
Case 37	Radial	Ceiling/Low 50/50	15	18.8	65.8	20.7	69.3

Case Name	Supply Diffuser Type	Exhaust Location and Number	Supply ACH	Supply Temperature (°C)	Supply Temperature (°F)	Room Temp (°C)	Room Temp (°F)
Case 85	Radial	Low	15	17.5	63.5	20.7	69.3
Case 38	Slot	Ceiling/Low 50/50	15	18.8	65.8	20.8	69.4
Case 39	Low Ind	Ceiling/Low 50/50	15	18.8	65.8	20.8	69.4
Case 65	Low Ind	Low	15	17.5	63.5	20.8	69.5
Case 13	Slot	Low	15	20.7	69.3	20.8	69.5
Case 10	Radial	Ceiling	15	20.7	69.3	20.9	69.7
Case 72	Radial	High x4 / Low x2	15	18.8	65.8	21.1	69.9
Case 74	Low Ind	High x4 / Low x2	15	18.8	65.8	21.1	70.0
Case 75	Radial	Ceiling/Low 50/50	15	18.8	65.8	21.1	70.0
Case 73	Slot	High x4 / Low x2	15	18.8	65.8	21.1	70.0
Case 14	Low Ind	Ceiling	15	20.7	69.3	21.1	70.0
Case 12	Slot	Ceiling	15	20.7	69.3	21.1	70.0
Case 64	Low Ind	Low	20	18.9	66.0	21.2	70.1
Case 86	Slot	Low	15	17.5	63.5	21.2	70.1
Case 29	Low Ind	Low	5	11	51.8	21.2	70.1
Case 15	Low Ind	Low	15	20.7	69.3	21.2	70.2
Case 68	Low Ind	Low	20	18.9	66.0	21.2	70.2
Case 22	Radial	Low	15	18.8	65.8	21.2	70.2
Case 69	Radial	High x4 / Low x4	15	18.8	65.8	21.3	70.3
Case 82	Radial	2 Door exhausts	15	18.8	65.8	21.3	70.3
Case 11	Radial	Low	15	20.7	69.3	21.3	70.4
Case 31	Radial	Low	15	17.5	63.5	21.4	70.5
Case 83	Slot	2 Door exhausts	15	17.5	63.5	21.4	70.6
Case 70	Slot	High x4 / Low x4	15	18.8	65.8	21.4	70.6
Case 84	Low Ind	2 Door exhausts	15	17.5	63.5	21.5	70.7
Case 71	Low Ind	High x4 / Low x4	15	18.8	65.8	21.6	70.8
Case 57	Radial	Low	15	18.8	65.8	21.7	71.1
Case 23	Slot	Low	15	18.8	65.8	21.8	71.2
Case 58	Slot	High	15	18.8	65.8	21.8	71.2
Case 79	Radial	2 Door exhausts	15	18.8	65.8	21.9	71.5
Case 32	Slot	Low	15	17.5	63.5	22.0	71.5
Case 33	Low Ind	Low	15	17.5	63.5	22.0	71.5
Case 61	Low Ind	Low	15	18.8	65.8	22.0	71.7
Case 03	Radial	Low	15	18.8	65.8	22.1	71.7
Case 80	Slot	2 Door exhausts	15	18.8	65.8	22.1	71.8
Case 24	Low Ind	Low	15	18.8	65.8	22.1	71.8
Case 06	Slot	Low	15	18.8	65.8	22.3	72.1
Case 28	Low Ind	Low	10	16.8	62.2	22.3	72.1
Case 81	Low Ind	2 Door exhausts	15	18.8	65.8	22.5	72.4
Case 87	Radial	Low	15	19.2	66.6	22.5	72.4
Case 88	Slot	Low	15	19.2	66.6	22.6	72.6
Case 09	Low Ind	Low	15	18.8	65.8	22.6	72.6
Case 30	Low Ind	Low	20	19.8	67.6	22.6	72.6
Case 89	Low Ind	Low	15	19.2	66.6	22.9	73.3

Table 3.02 Ranking of Cases with respect to Cage Temperature

Case Name	Supply Diffuser Type	Exhaust Location and Number	Supply ACH	Supply Temperature (°C)	Supply Temperature (°F)	Cage Temp (°C)	Cage Temp (°F)
Case 66	Low Ind	Low	5	6.6	43.9	20.6	69.1
Case 62	Low Ind	Low	5	6.6	43.9	20.9	69.6
Case 35	Slot	Ceiling	15	17.5	63.5	21.3	70.4
Case 34	Radial	Ceiling	15	17.5	63.5	21.4	70.4
Case 36	Low Ind	Ceiling	15	17.5	63.5	21.5	70.6
Case 55	Low Ind	Ceiling	15	18.8	65.8	21.6	70.9
Case 97	Slot	Ceiling	15	17.5	63.5	21.6	71.0
Case 54	Slot	Ceiling	15	18.8	65.8	21.7	71.0
Case 53	Radial	Ceiling	15	18.8	65.8	21.7	71.0
Case 98	Low ind	Ceiling	15	17.5	63.5	21.7	71.1
Case 19	Radial	Ceiling	15	18.8	65.8	21.7	71.1
Case 96	Radial	Ceiling	15	17.5	63.5	21.8	71.2
Case 94	Slot	Ceiling	15	17.5	63.5	21.9	71.3
Case 67	Low Ind	Low	10	14.8	58.6	21.9	71.4
Case 75	Radial	Ceiling/Low 50/50	15	18.8	65.8	21.9	71.4
Case 60	Low Ind	High	15	18.8	65.8	21.9	71.4
Case 63	Low Ind	Low	10	14.8	58.6	21.9	71.4
Case 90	Radial	Ceiling	15	18.8	65.8	21.9	71.5
Case 95	Low Ind	Ceiling	15	17.5	63.5	21.9	71.5
Case 93	Radial	Ceiling	15	17.5	63.5	21.9	71.5
Case 92	Low Ind	Ceiling	15	18.8	65.8	22.0	71.6
Case 91	Slot	Ceiling	15	18.8	65.8	22.0	71.6
Case 43	Low Ind (rot 90°)	Ceiling	15	18.8	65.8	22.0	71.6
Case 46	Radial	Ceiling	15	18.8	65.8	22.0	71.6
Case 21	Low Ind	Ceiling	15	18.8	65.8	22.0	71.6
Case 59	Slot	Low	15	18.8	65.8	22.0	71.6
Basecase	Radial	Ceiling	15	18.8	65.8	22.1	71.7
Case 18	Low Ind	Ceiling	15	18.8	65.8	22.1	71.7
Case 45	Radial	Ceiling	15	18.8	65.8	22.1	71.7
Case 17	Slot	Ceiling	15	18.8	65.8	22.1	71.7
Case 20	Slot	Ceiling	15	18.8	65.8	22.1	71.7
Case 47	Radial	Ceiling	15	18.8	65.8	22.1	71.7
Case 78	Low Ind	Ceiling	15	18.8	65.8	22.1	71.8
Case 56	Radial	High	15	18.8	65.8	22.1	71.8
Case 27	Low Ind	Ceiling	15	18.8	65.8	22.1	71.8
Case 48	Radial	Ceiling	15	18.8	65.8	22.1	71.8
Case 76	Radial	Ceiling	15	18.8	65.8	22.1	71.8
Case 26	Slot	Ceiling	15	18.8	65.8	22.1	71.8
Case 77	Slot	Ceiling	15	18.8	65.8	22.1	71.9
Case 44	Radial (rot 90°)	Ceiling	15	18.8	65.8	22.2	71.9
Case 04	Slot	Ceiling	15	18.8	65.8	22.2	71.9
Case 50	Radial	Ceiling	15	18.8	65.8	22.2	71.9
Case 49	Radial	Ceiling	15	18.8	65.8	22.2	71.9
Case 40	Radial	Ceiling x4	15	18.8	65.8	22.2	71.9
Case 42	Low Ind	Ceiling x4	15	18.8	65.8	22.2	71.9
Case 51	Radial	Ceiling	15	18.8	65.8	22.2	71.9
Case 25	Radial	Ceiling	15	18.8	65.8	22.2	72.0
Case 83	Slot	2 Door exhausts	15	17.5	63.5	22.2	72.0
Case 08	Low Ind	High	15	18.8	65.8	22.2	72.0
Case 41	Slot	Ceiling x4	15	18.8	65.8	22.2	72.0
Case 37	Radial	Ceiling/Low 50/50	15	18.8	65.8	22.3	72.1
Case 05	Slot	High	15	18.8	65.8	22.3	72.1
Case 82	Radial	2 Door exhausts	15	18.8	65.8	22.3	72.1
Case 86	Slot	Low	15	17.5	63.5	22.3	72.1

Case Name	Supply Diffuser Type	Exhaust Location and Number	Supply ACH	Supply Temperature (°C)	Supply Temperature (°F)	Cage Temp (°C)	Cage Temp (°F)
Case 02	Radial	High	15	18.8	65.9	22.3	72.2
Case 85	Radial	Low	15	17.5	63.5	22.4	72.3
Case 38	Slot	Ceiling/Low 50/50	15	18.8	65.8	22.4	72.3
Case 39	Low Ind	Ceiling/Low 50/50	15	18.8	65.8	22.4	72.3
Case 65	Low Ind	Low	15	17.5	63.5	22.4	72.4
Case 07	Low Ind	Ceiling	15	18.8	65.8	22.5	72.4
Case 52	Radial	Ceiling	15	18.8	65.8	22.5	72.5
Case 22	Radial	Low	15	18.8	65.8	22.5	72.5
Case 84	Low Ind	2 Door exhausts	15	17.5	63.5	22.5	72.5
Case 72	Radial	High x4 / Low x2	15	18.8	65.8	22.5	72.6
Case 73	Slot	High x4 / Low x2	15	18.8	65.8	22.6	72.7
Case 74	Low Ind	High x4 / Low x2	15	18.8	65.8	22.6	72.7
Case 29	Low Ind	Low	5	11	51.8	22.6	72.8
Case 87	Radial	Low	15	19.2	66.6	22.7	72.8
Case 64	Low Ind	Low	20	18.9	66.0	22.7	72.8
Case 31	Radial	Low	15	17.5	63.5	22.7	72.8
Case 23	Slot	Low	15	18.8	65.8	22.7	72.9
Case 69	Radial	High x4 / Low x4	15	18.8	65.8	22.7	72.9
Case 11	Radial	Low	15	20.7	69.3	22.7	72.9
Case 68	Low Ind	Low	20	18.9	66.0	22.8	73.0
Case 13	Slot	Low	15	20.7	69.3	22.8	73.0
Case 14	Low Ind	Ceiling	15	20.7	69.3	22.8	73.0
Case 16	Radial	Ceiling	15	18.8	65.8	22.9	73.1
Case 70	Slot	High x4 / Low x4	15	18.8	65.8	22.9	73.2
Case 32	Slot	Low	15	17.5	63.5	22.9	73.2
Case 12	Slot	Ceiling	15	20.7	69.3	22.9	73.2
Case 71	Low Ind	High x4 / Low x4	15	18.8	65.8	23.0	73.3
Case 57	Radial	Low	15	18.8	65.8	23.0	73.4
Case 58	Slot	High	15	18.8	65.8	23.1	73.5
Case 79	Radial	2 Door exhausts	15	18.8	65.8	23.1	73.6
Case 61	Low Ind	Low	15	18.8	65.8	23.1	73.6
Case 33	Low Ind	Low	15	17.5	63.5	23.2	73.7
Case 24	Low Ind	Low	15	18.8	65.8	23.2	73.7
Case 80	Slot	2 Door exhausts	15	18.8	65.8	23.2	73.8
Case 10	Radial	Ceiling	15	20.7	69.3	23.2	73.8
Case 15	Low Ind	Low	15	20.7	69.3	23.2	73.8
Case 28	Low Ind	Low	10	16.8	62.2	23.3	74.0
Case 03	Radial	Low	15	18.8	65.8	23.4	74.0
Case 81	Low Ind	2 Door exhausts	15	18.8	65.8	23.4	74.1
Case 06	Slot	Low	15	18.8	65.8	23.4	74.2
Case 88	Slot	Low	15	19.2	66.6	23.5	74.4
Case 09	Low Ind	Low	15	18.8	65.8	23.6	74.5
Case 30	Low Ind	Low	20	19.8	67.6	23.6	74.6
Case 89	Low Ind	Low	15	19.2	66.6	23.7	74.6

Table 3.03 Ranking of Cases with respect to Room Relative Humidity

Case Name	Supply Diffuser Type	Exhaust Location and Number	Supply ACH	Supply Temperature (°C)	Supply Temperature (°F)	Room RH (percent)
Case 89	Low Ind	Low	15	19.2	66.6	47.1
Case 88	Slot	Low	15	19.2	66.6	48.1
Case 30	Low Ind	Low	20	19.8	67.6	48.2
Case 09	Low Ind	Low	15	18.8	65.8	48.4
Case 87	Radial	Low	15	19.2	66.6	48.4
Case 81	Low Ind	2 Door exhausts	15	18.8	65.8	48.7
Case 06	Slot	Low	15	18.8	65.8	49.2
Case 28	Low Ind	Low	10	16.8	62.2	49.5
Case 03	Radial	Low	15	18.8	65.8	49.7
Case 24	Low Ind	Low	15	18.8	65.8	49.8
Case 80	Slot	2 Door exhausts	15	18.8	65.8	49.8
Case 61	Low Ind	Low	15	18.8	65.8	49.8
Case 79	Radial	2 Door exhausts	15	18.8	65.8	50.3
Case 32	Slot	Low	15	17.5	63.5	50.5
Case 58	Slot	High	15	18.8	65.8	50.6
Case 33	Low Ind	Low	15	17.5	63.5	50.7
Case 23	Slot	Low	15	18.8	65.8	50.7
Case 57	Radial	Low	15	18.8	65.8	50.7
Case 71	Low Ind	High x4 / Low x4	15	18.8	65.8	51.2
Case 70	Slot	High x4 / Low x4	15	18.8	65.8	51.4
Case 11	Radial	Low	15	20.7	69.3	52.0
Case 69	Radial	High x4 / Low x4	15	18.8	65.8	52.2
Case 31	Radial	Low	15	17.5	63.5	52.3
Case 15	Low Ind	Low	15	20.7	69.3	52.3
Case 84	Low Ind	2 Door exhausts	15	17.5	63.5	52.3
Case 22	Radial	Low	15	18.8	65.8	52.3
Case 12	Slot	Ceiling	15	20.7	69.3	52.3
Case 73	Slot	High x4 / Low x2	15	18.8	65.8	52.6
Case 83	Slot	2 Door exhausts	15	17.5	63.5	52.6
Case 68	Low Ind	Low	20	18.9	66.0	52.7
Case 14	Low Ind	Ceiling	15	20.7	69.3	52.7
Case 74	Low Ind	High x4 / Low x2	15	18.8	65.8	52.7
Case 75	Radial	Ceiling/Low 50/50	15	18.8	65.8	52.7
Case 82	Radial	2 Door exhausts	15	18.8	65.8	52.8
Case 72	Radial	High x4 / Low x2	15	18.8	65.8	52.8
Case 64	Low Ind	Low	20	18.9	66.0	52.9
Case 86	Slot	Low	15	17.5	63.5	53.1
Case 10	Radial	Ceiling	15	20.7	69.3	53.1
Case 29	Low Ind	Low	5	11	51.8	53.2
Case 13	Slot	Low	15	20.7	69.3	53.5
Case 38	Slot	Ceiling/Low 50/50	15	18.8	65.8	53.9
Case 39	Low Ind	Ceiling/Low 50/50	15	18.8	65.8	54.0
Case 37	Radial	Ceiling/Low 50/50	15	18.8	65.8	54.2
Case 02	Radial	High	15	18.8	65.8	54.3
Case 40	Radial	Ceiling x4	15	18.8	65.8	54.4
Case 65	Low Ind	Low	15	17.5	63.5	54.4
Case 48	Radial	Ceiling	15	18.8	65.8	54.5
Case 49	Radial	Ceiling	15	18.8	65.8	54.6
Case 05	Slot	High	15	18.8	65.8	54.6
Case 41	Slot	Ceiling x4	15	18.8	65.8	54.6
Case 85	Radial	Low	15	17.5	63.5	54.7
Case 20	Slot	Ceiling	15	18.8	65.8	54.8
Case 42	Low Ind	Ceiling x4	15	18.8	65.8	54.8
Case 51	Radial	Ceiling	15	18.8	65.8	54.8

Case Name	Supply Diffuser Type	Exhaust Location and Number	Supply ACH	Supply Temperature (°C)	Supply Temperature (°F)	Room RH (percent)
Case 50	Radial	Ceiling	15	18.8	65.8	54.9
Case 91	Slot	Ceiling	15	18.8	65.8	55.0
Case 08	Low Ind	High	15	18.8	65.8	55.0
Case 26	Slot	Ceiling	15	18.8	65.8	55.0
Case 59	Slot	Low	15	18.8	65.8	55.0
Case 52	Radial	Ceiling	15	18.8	65.8	55.0
Case 92	Low Ind	Ceiling	15	18.8	65.8	55.0
Case 78	Low Ind	Ceiling	15	18.8	65.8	55.1
Case 04	Slot	Ceiling	15	18.8	65.8	55.1
Case 77	Slot	Ceiling	15	18.8	65.8	55.2
Case 44	Radial (rot 90°)	Ceiling	15	18.8	65.8	55.2
Case 76	Radial	Ceiling	15	18.8	65.8	55.2
Case 21	Low Ind	Ceiling	15	18.8	65.8	55.2
Case 90	Radial	Ceiling	15	18.8	65.8	55.4
Basecase	Radial	Ceiling	15	18.8	65.8	55.4
Case 56	Radial	High	15	18.8	65.8	55.5
Case 47	Radial	Ceiling	15	18.8	65.8	55.5
Case 27	Low Ind	Ceiling	15	18.8	65.8	55.5
Case 25	Radial	Ceiling	15	18.8	65.8	55.6
Case 45	Radial	Ceiling	15	18.8	65.8	55.6
Case 60	Low Ind	High	15	18.8	65.8	55.6
Case 43	Low Ind (rot 90°)	Ceiling	15	18.8	65.8	55.8
Case 95	Low Ind	Ceiling	15	17.5	63.5	55.9
Case 46	Radial	Ceiling	15	18.8	65.8	55.9
Case 19	Radial	Ceiling	15	18.8	65.8	55.9
Case 93	Radial	Ceiling	15	17.5	63.5	55.9
Case 17	Slot	Ceiling	15	18.8	65.8	56.0
Case 18	Low Ind	Ceiling	15	18.8	65.8	56.0
Case 16	Radial	Ceiling	15	18.8	65.8	56.2
Case 94	Slot	Ceiling	15	17.5	63.5	56.3
Case 07	Low Ind	Ceiling	15	18.8	65.8	56.7
Case 63	Low Ind	Low	10	14.8	58.6	56.8
Case 98	Low ind	Ceiling	15	17.5	63.5	56.9
Case 96	Radial	Ceiling	15	17.5	63.5	57.0
Case 97	Slot	Ceiling	15	17.5	63.5	57.0
Case 67	Low Ind	Low	10	14.8	58.6	57.2
Case 35	Slot	Ceiling	15	17.5	63.5	57.4
Case 55	Low Ind	Ceiling	15	18.8	65.8	57.4
Case 54	Slot	Ceiling	15	18.8	65.8	57.4
Case 53	Radial	Ceiling	15	18.8	65.8	57.5
Case 34	Radial	Ceiling	15	17.5	63.5	57.5
Case 36	Low Ind	Ceiling	15	17.5	63.5	57.7
Case 62	Low Ind	Low	5	6.6	43.9	62.6
Case 66	Low Ind	Low	5	6.6	43.9	64.4

Table 3.04 Ranking of Cases with respect to Cage RH

Case Name	Supply Diffuser Type	Exhaust Location and Number	Supply ACH	Supply Temperature (°C)	Supply Temperature (°F)	Cage RH (percent)
Case 62	Low Ind	Low	5	6.6	43.9	52.8
Case 66	Low Ind	Low	5	6.6	43.9	53.0
Case 84	Low Ind	2 Door exhausts	15	17.5	63.5	53.0
Case 29	Low Ind	Low	5	11	51.8	55.8
Case 87	Radial	Low	15	19.2	66.6	56.3
Case 64	Low Ind	Low	20	18.9	66.0	56.5
Case 23	Slot	Low	15	18.8	65.8	56.9
Case 69	Radial	High x4 / Low x4	15	18.8	65.8	57.1
Case 68	Low Ind	Low	20	18.9	66.0	57.5
Case 32	Slot	Low	15	17.5	63.5	57.5
Case 57	Radial	Low	15	18.8	65.8	58.3
Case 79	Radial	2 Door exhausts	15	18.8	65.8	58.6
Case 33	Low Ind	Low	15	17.5	63.5	58.7
Case 24	Low Ind	Low	15	18.8	65.8	58.7
Case 80	Slot	2 Door exhausts	15	18.8	65.8	59.1
Case 28	Low Ind	Low	10	16.8	62.2	59.1
Case 03	Radial	Low	15	18.8	65.8	60.2
Case 81	Low Ind	2 Door exhausts	15	18.8	65.8	60.2
Case 06	Slot	Low	15	18.8	65.8	60.2
Case 88	Slot	Low	15	19.2	66.6	60.4
Case 09	Low Ind	Low	15	18.8	65.8	60.6
Case 30	Low Ind	Low	20	19.8	67.6	60.9
Case 89	Low Ind	Low	15	19.2	66.6	60.9
Case 22	Radial	Low	15	18.8	65.8	61.1
Case 31	Radial	Low	15	17.5	63.5	61.4
Case 58	Slot	High	15	18.8	65.8	61.4
Case 61	Low Ind	Low	15	18.8	65.8	61.6
Case 71	Low Ind	High x4 / Low x4	15	18.8	65.8	61.6
Case 10	Radial	Ceiling	15	20.7	69.3	61.7
Case 15	Low Ind	Low	15	20.7	69.3	61.7
Case 70	Slot	High x4 / Low x4	15	18.8	65.8	61.8
Case 82	Radial	2 Door exhausts	15	18.8	65.8	61.9
Case 72	Radial	High x4 / Low x2	15	18.8	65.8	61.9
Case 86	Slot	Low	15	17.5	63.5	62.0
Case 02	Radial	High	15	18.8	65.8	62.0
Case 41	Slot	Ceiling x4	15	18.8	65.8	62.3
Case 74	Low Ind	High x4 / Low x2	15	18.8	65.8	62.3
Case 37	Radial	Ceiling/Low 50/50	15	18.8	65.8	62.4
Case 38	Slot	Ceiling/Low 50/50	15	18.8	65.8	62.4
Case 05	Slot	High	15	18.8	65.8	62.5
Case 20	Slot	Ceiling	15	18.8	65.8	62.6
Case 65	Low Ind	Low	15	17.5	63.5	62.7
Case 04	Slot	Ceiling	15	18.8	65.8	62.7
Case 42	Low Ind	Ceiling x4	15	18.8	65.8	62.8
Case 92	Low Ind	Ceiling	15	18.8	65.8	62.8
Case 85	Radial	Low	15	17.5	63.5	62.8
Case 39	Low Ind	Ceiling/Low 50/50	15	18.8	65.8	62.9
Case 73	Slot	High x4 / Low x2	15	18.8	65.8	62.9
Case 90	Radial	Ceiling	15	18.8	65.8	63.3
Case 91	Slot	Ceiling	15	18.8	65.8	63.4
Case 11	Radial	Low	15	20.7	69.3	63.6
Case 12	Slot	Ceiling	15	20.7	69.3	63.6
Case 50	Radial	Ceiling	15	18.8	65.8	63.7
Case 18	Low Ind	Ceiling	15	18.8	65.8	63.8

Case Name	Supply Diffuser Type	Exhaust Location and Number	Supply ACH	Supply Temperature (°C)	Supply Temperature (°F)	Cage RH (percent)
Case 08	Low Ind	High	15	18.8	65.8	63.8
Case 17	Slot	Ceiling	15	18.8	65.8	63.9
Case 16	Radial	Ceiling	15	18.8	65.8	64.0
Case 76	Radial	Ceiling	15	18.8	65.8	64.1
Case 21	Low Ind	Ceiling	15	18.8	65.8	64.1
Case 95	Low Ind	Ceiling	15	17.5	63.5	64.1
Case 77	Slot	Ceiling	15	18.8	65.8	64.2
Case 14	Low Ind	Ceiling	15	20.7	69.3	64.2
Case 97	Slot	Ceiling	15	17.5	63.5	64.2
Case 94	Slot	Ceiling	15	17.5	63.5	64.4
Case 56	Radial	High	15	18.8	65.8	64.4
Case 43	Low Ind (rot 90°)	Ceiling	15	18.8	65.8	64.6
Case 19	Radial	Ceiling	15	18.8	65.8	64.6
Case 78	Low Ind	Ceiling	15	18.8	65.8	64.7
Case 52	Radial	Ceiling	15	18.8	65.8	64.8
Case 40	Radial	Ceiling x4	15	18.8	65.8	64.8
Case 45	Radial	Ceiling	15	18.8	65.8	64.9
Case 75	Radial	Ceiling/Low 50/50	15	18.8	65.8	64.9
Case 63	Low Ind	Low	10	14.8	58.6	64.9
Case 93	Radial	Ceiling	15	17.5	63.5	65.0
Case 47	Radial	Ceiling	15	18.8	65.8	65.1
Case 49	Radial	Ceiling	15	18.8	65.8	65.2
Case 46	Radial	Ceiling	15	18.8	65.8	65.2
Case 51	Radial	Ceiling	15	18.8	65.8	65.3
Case 35	Slot	Ceiling	15	17.5	63.5	65.5
Case 67	Low Ind	Low	10	14.8	58.6	65.8
Case 98	Low ind	Ceiling	15	17.5	63.5	65.8
Case 96	Radial	Ceiling	15	17.5	63.5	65.8
Case 54	Slot	Ceiling	15	18.8	65.8	66.0
Case 44	Radial (rot 90°)	Ceiling	15	18.8	65.8	66.0
Case 48	Radial	Ceiling	15	18.8	65.8	66.1
Case 07	Low Ind	Ceiling	15	18.8	65.8	66.4
Case 13	Slot	Low	15	20.7	69.3	66.5
Case 36	Low Ind	Ceiling	15	17.5	63.5	66.5
Basecase	Radial	Ceiling	15	18.8	65.8	66.8
Case 83	Slot	2 Door exhausts	15	17.5	63.5	66.8
Case 59	Slot	Low	15	18.8	65.8	66.9
Case 34	Radial	Ceiling	15	17.5	63.5	67.2
Case 55	Low Ind	Ceiling	15	18.8	65.8	67.8
Case 53	Radial	Ceiling	15	18.8	65.8	68.8
Case 60	Low Ind	High	15	18.8	65.8	69.1
Case 25	Radial	Ceiling	15	18.8	65.8	73.0
Case 27	Low Ind	Ceiling	15	18.8	65.8	74.8
Case 26	Slot	Ceiling	15	18.8	65.8	81.2

Table 3.05 Ranking of Cases with respect to Room CO₂

Case Name	Supply Diffuser Type	Exhaust Location and Number	Supply ACH	Supply Temperature (°C)	Supply Temperature (°F)	Room CO ₂ (ppm)
Case 59	Slot	Low	15	18.8	65.8	15
Case 12	Slot	Ceiling	15	20.7	69.3	17
Case 40	Radial	Ceiling x4	15	18.8	65.8	21
Case 70	Slot	High x4 / Low x4	15	18.8	65.8	24
Case 10	Radial	Ceiling	15	20.7	69.3	29
Case 26	Slot	Ceiling	15	18.8	65.8	35
Basecase	Radial	Ceiling	15	18.8	65.8	36
Case 13	Slot	Low	15	20.7	69.3	37
Case 16	Radial	Ceiling	15	18.8	65.8	37
Case 73	Slot	High x4 / Low x2	15	18.8	65.8	37
Case 47	Radial	Ceiling	15	18.8	65.8	40
Case 92	Low Ind	Ceiling	15	18.8	65.8	41
Case 46	Radial	Ceiling	15	18.8	65.8	43
Case 87	Radial	Low	15	19.2	66.6	45
Case 11	Radial	Low	15	20.7	69.3	48
Case 74	Low Ind	High x4 / Low x2	15	18.8	65.8	48
Case 75	Radial	Ceiling/Low 50/50	15	18.8	65.8	48
Case 88	Slot	Low	15	19.2	66.6	48
Case 15	Low Ind	Low	15	20.7	69.3	48
Case 72	Radial	High x4 / Low x2	15	18.8	65.8	48
Case 05	Slot	High	15	18.8	65.8	49
Case 77	Slot	Ceiling	15	18.8	65.8	50
Case 41	Slot	Ceiling x4	15	18.8	65.8	51
Case 69	Radial	High x4 / Low x4	15	18.8	65.8	51
Case 71	Low Ind	High x4 / Low x4	15	18.8	65.8	51
Case 49	Radial	Ceiling	15	18.8	65.8	52
Case 14	Low Ind	Ceiling	15	20.7	69.3	52
Case 45	Radial	Ceiling	15	18.8	65.8	52
Case 50	Radial	Ceiling	15	18.8	65.8	55
Case 76	Radial	Ceiling	15	18.8	65.8	55
Case 78	Low Ind	Ceiling	15	18.8	65.8	55
Case 60	Low Ind	High	15	18.8	65.8	57
Case 07	Low Ind	Ceiling	15	18.8	65.8	57
Case 55	Low Ind	Ceiling	15	18.8	65.8	57
Case 91	Slot	Ceiling	15	18.8	65.8	57
Case 57	Radial	Low	15	18.8	65.8	57
Case 53	Radial	Ceiling	15	18.8	65.8	58
Case 37	Radial	Ceiling/Low 50/50	15	18.8	65.8	59
Case 19	Radial	Ceiling	15	18.8	65.8	59
Case 54	Slot	Ceiling	15	18.8	65.8	60
Case 25	Radial	Ceiling	15	18.8	65.8	60
Case 22	Radial	Low	15	18.8	65.8	61
Case 27	Low Ind	Ceiling	15	18.8	65.8	61
Case 21	Low Ind	Ceiling	15	18.8	65.8	62
Case 04	Slot	Ceiling	15	18.8	65.8	62
Case 89	Low Ind	Low	15	19.2	66.6	62
Case 38	Slot	Ceiling/Low 50/50	15	18.8	65.8	62
Case 23	Slot	Low	15	18.8	65.8	63
Case 42	Low Ind	Ceiling x4	15	18.8	65.8	63
Case 30	Low Ind	Low	20	19.8	67.6	64
Case 08	Low Ind	High	15	18.8	65.8	64
Case 03	Radial	Low	15	18.8	65.8	64
Case 48	Radial	Ceiling	15	18.8	65.8	65
Case 02	Radial	High	15	18.8	65.8	65

Case Name	Supply Diffuser Type	Exhaust Location and Number	Supply ACH	Supply Temperature (°C)	Supply Temperature (°F)	Room CO ₂ (ppm)
Case 52	Radial	Ceiling	15	18.8	65.8	65
Case 43	Low Ind (rot 90°)	Ceiling	15	18.8	65.8	65
Case 51	Radial	Ceiling	15	18.8	65.8	67
Case 58	Slot	High	15	18.8	65.8	68
Case 61	Low Ind	Low	15	18.8	65.8	69
Case 56	Radial	High	15	18.8	65.8	69
Case 95	Low Ind	Ceiling	15	17.5	63.5	69
Case 39	Low Ind	Ceiling/Low 50/50	15	18.8	65.8	71
Case 06	Slot	Low	15	18.8	65.8	72
Case 90	Radial	Ceiling	15	18.8	65.8	72
Case 44	Radial (rot 90°)	Ceiling	15	18.8	65.8	74
Case 20	Slot	Ceiling	15	18.8	65.8	75
Case 17	Slot	Ceiling	15	18.8	65.8	78
Case 18	Low Ind	Ceiling	15	18.8	65.8	79
Case 79	Radial	2 Door exhausts	15	18.8	65.8	81
Case 24	Low Ind	Low	15	18.8	65.8	81
Case 98	Low ind	Ceiling	15	17.5	63.5	83
Case 93	Radial	Ceiling	15	17.5	63.5	86
Case 09	Low Ind	Low	15	18.8	65.8	88
Case 81	Low Ind	2 Door exhausts	15	18.8	65.8	89
Case 80	Slot	2 Door exhausts	15	18.8	65.8	90
Case 68	Low Ind	Low	20	18.9	66.0	93
Case 64	Low Ind	Low	20	18.9	66.0	93
Case 96	Radial	Ceiling	15	17.5	63.5	100
Case 31	Radial	Low	15	17.5	63.5	107
Case 97	Slot	Ceiling	15	17.5	63.5	111
Case 28	Low Ind	Low	10	16.8	62.2	113
Case 82	Radial	2 Door exhausts	15	18.8	65.8	116
Case 94	Slot	Ceiling	15	17.5	63.5	117
Case 35	Slot	Ceiling	15	17.5	63.5	122
Case 86	Slot	Low	15	17.5	63.5	124
Case 32	Slot	Low	15	17.5	63.5	125
Case 85	Radial	Low	15	17.5	63.5	132
Case 65	Low Ind	Low	15	17.5	63.5	133
Case 36	Low Ind	Ceiling	15	17.5	63.5	134
Case 34	Radial	Ceiling	15	17.5	63.5	136
Case 29	Low Ind	Low	5	11	51.8	140
Case 33	Low Ind	Low	15	17.5	63.5	143
Case 84	Low Ind	2 Door exhausts	15	17.5	63.5	152
Case 83	Slot	2 Door exhausts	15	17.5	63.5	167
Case 67	Low Ind	Low	10	14.8	58.6	201
Case 63	Low Ind	Low	10	14.8	58.6	215
Case 66	Low Ind	Low	5	6.6	43.9	318
Case 62	Low Ind	Low	5	6.6	43.9	342

Table 3.06 Ranking of Cases with respect to Cage CO₂

Case Name	Supply Diffuser Type	Exhaust Location and Number	Supply ACH	Supply Temperature (°C)	Supply Temperature (°F)	Cage CO ₂ (ppm)
Case 87	Radial	Low	15	19.2	66.6	1391
Case 88	Slot	Low	15	19.2	66.6	1550
Case 03	Radial	Low	15	18.8	65.8	1568
Case 92	Low Ind	Ceiling	15	18.8	65.8	1631
Case 89	Low Ind	Low	15	19.2	66.6	1636
Case 79	Radial	2 Door exhausts	15	18.8	65.8	1647
Case 23	Slot	Low	15	18.8	65.8	1652
Case 06	Slot	Low	15	18.8	65.8	1652
Case 20	Slot	Ceiling	15	18.8	65.8	1656
Case 52	Radial	Ceiling	15	18.8	65.8	1665
Case 22	Radial	Low	15	18.8	65.8	1665
Case 82	Radial	2 Door exhausts	15	18.8	65.8	1667
Case 30	Low Ind	Low	20	19.8	67.6	1667
Case 90	Radial	Ceiling	15	18.8	65.8	1673
Case 41	Slot	Ceiling x4	15	18.8	65.8	1690
Case 02	Radial	High	15	18.8	65.8	1703
Case 80	Slot	2 Door exhausts	15	18.8	65.8	1707
Case 04	Slot	Ceiling	15	18.8	65.8	1709
Case 91	Slot	Ceiling	15	18.8	65.8	1709
Case 37	Radial	Ceiling/Low 50/50	15	18.8	65.8	1715
Case 97	Slot	Ceiling	15	17.5	63.5	1725
Case 09	Low Ind	Low	15	18.8	65.8	1725
Case 19	Radial	Ceiling	15	18.8	65.8	1725
Case 42	Low Ind	Ceiling x4	15	18.8	65.8	1728
Case 81	Low Ind	2 Door exhausts	15	18.8	65.8	1741
Case 05	Slot	High	15	18.8	65.8	1742
Case 32	Slot	Low	15	17.5	63.5	1747
Case 28	Low Ind	Low	10	16.8	62.2	1749
Case 69	Radial	High x4 / Low x4	15	18.8	65.8	1750
Case 83	Slot	2 Door exhausts	15	17.5	63.5	1756
Case 94	Slot	Ceiling	15	17.5	63.5	1757
Case 35	Slot	Ceiling	15	17.5	63.5	1761
Case 29	Low Ind	Low	5	11	51.8	1764
Case 38	Slot	Ceiling/Low 50/50	15	18.8	65.8	1776
Case 72	Radial	High x4 / Low x2	15	18.8	65.8	1790
Case 18	Low Ind	Ceiling	15	18.8	65.8	1791
Case 64	Low Ind	Low	20	18.9	66.0	1808
Case 21	Low Ind	Ceiling	15	18.8	65.8	1808
Case 17	Slot	Ceiling	15	18.8	65.8	1815
Case 95	Low Ind	Ceiling	15	17.5	63.5	1822
Case 93	Radial	Ceiling	15	17.5	63.5	1822
Case 68	Low Ind	Low	20	18.9	66.0	1838
Case 75	Radial	Ceiling/Low 50/50	15	18.8	65.8	1839
Case 50	Radial	Ceiling	15	18.8	65.8	1840
Case 39	Low Ind	Ceiling/Low 50/50	15	18.8	65.8	1848
Case 84	Low Ind	2 Door exhausts	15	17.5	63.5	1853
Case 57	Radial	Low	15	18.8	65.8	1855
Case 43	Low Ind (rot 90°)	Ceiling	15	18.8	65.8	1855
Case 76	Radial	Ceiling	15	18.8	65.8	1857
Case 54	Slot	Ceiling	15	18.8	65.8	1869
Case 08	Low Ind	High	15	18.8	65.8	1871
Case 36	Low Ind	Ceiling	15	17.5	63.5	1878
Case 77	Slot	Ceiling	15	18.8	65.8	1881
Case 24	Low Ind	Low	15	18.8	65.8	1883

Case Name	Supply Diffuser Type	Exhaust Location and Number	Supply ACH	Supply Temperature (°C)	Supply Temperature (°F)	Cage CO ₂ (ppm)
Case 74	Low Ind	High x4 / Low x2	15	18.8	65.8	1884
Case 56	Radial	High	15	18.8	65.8	1886
Case 34	Radial	Ceiling	15	17.5	63.5	1896
Case 86	Slot	Low	15	17.5	63.5	1917
Case 78	Low Ind	Ceiling	15	18.8	65.8	1919
Case 45	Radial	Ceiling	15	18.8	65.8	1929
Case 85	Radial	Low	15	17.5	63.5	1930
Case 31	Radial	Low	15	17.5	63.5	1938
Case 46	Radial	Ceiling	15	18.8	65.8	1943
Case 98	Low ind	Ceiling	15	17.5	63.5	1955
Case 70	Slot	High x4 / Low x4	15	18.8	65.8	1955
Case 96	Radial	Ceiling	15	17.5	63.5	1957
Case 47	Radial	Ceiling	15	18.8	65.8	1961
Case 73	Slot	High x4 / Low x2	15	18.8	65.8	1966
Case 71	Low Ind	High x4 / Low x4	15	18.8	65.8	1968
Case 33	Low Ind	Low	15	17.5	63.5	1974
Case 40	Radial	Ceiling x4	15	18.8	65.8	1975
Case 58	Slot	High	15	18.8	65.8	1990
Case 65	Low Ind	Low	15	17.5	63.5	2002
Case 49	Radial	Ceiling	15	18.8	65.8	2025
Case 55	Low Ind	Ceiling	15	18.8	65.8	2039
Case 61	Low Ind	Low	15	18.8	65.8	2042
Case 51	Radial	Ceiling	15	18.8	65.8	2045
Case 63	Low Ind	Low	10	14.8	58.6	2081
Case 48	Radial	Ceiling	15	18.8	65.8	2099
Case 11	Radial	Low	15	20.7	69.3	2118
Case 44	Radial (rot 90°)	Ceiling	15	18.8	65.8	2118
Case 10	Radial	Ceiling	15	20.7	69.3	2119
Case 15	Low Ind	Low	15	20.7	69.3	2119
Case 67	Low Ind	Low	10	14.8	58.6	2144
Basecase	Radial	Ceiling	15	18.8	65.8	2158
Case 59	Slot	Low	15	18.8	65.8	2161
Case 12	Slot	Ceiling	15	20.7	69.3	2208
Case 53	Radial	Ceiling	15	18.8	65.8	2212
Case 16	Radial	Ceiling	15	18.8	65.8	2213
Case 14	Low Ind	Ceiling	15	20.7	69.3	2215
Case 66	Low Ind	Low	5	6.6	43.9	2318
Case 07	Low Ind	Ceiling	15	18.8	65.8	2321
Case 62	Low Ind	Low	5	6.6	43.9	2325
Case 60	Low Ind	High	15	18.8	65.8	2354
Case 13	Slot	Low	15	20.7	69.3	2491
Case 25	Radial	Ceiling	15	18.8	65.8	3008
Case 27	Low Ind	Ceiling	15	18.8	65.8	3171
Case 26	Slot	Ceiling	15	18.8	65.8	3975

Table 3.07 Ranking of Cases with respect to Room NH₃

Case Name	Supply Diffuser Type	Exhaust Location and Number	Supply ACH	Supply Temperature (°C)	Supply Temperature (°F)	Room NH ₃ (day 4) (ppm)
Case 59	Slot	Low	15	18.8	65.8	0.04
Case 12	Slot	Ceiling	15	20.7	69.3	0.04
Case 70	Slot	High x4 / Low x4	15	18.8	65.8	0.06
Case 40	Radial	Ceiling x4	15	18.8	65.8	0.06
Case 10	Radial	Ceiling	15	20.7	69.3	0.07
Case 73	Slot	High x4 / Low x2	15	18.8	65.8	0.09
Case 16	Radial	Ceiling	15	18.8	65.8	0.10
Case 87	Radial	Low	15	19.2	66.6	0.10
Case 92	Low Ind	Ceiling	15	18.8	65.8	0.10
Basecase	Radial	Ceiling	15	18.8	65.8	0.11
Case 13	Slot	Low	15	20.7	69.3	0.11
Case 88	Slot	Low	15	19.2	66.6	0.11
Case 47	Radial	Ceiling	15	18.8	65.8	0.11
Case 15	Low Ind	Low	15	20.7	69.3	0.11
Case 72	Radial	High x4 / Low x2	15	18.8	65.8	0.11
Case 74	Low Ind	High x4 / Low x2	15	18.8	65.8	0.11
Case 69	Radial	High x4 / Low x4	15	18.8	65.8	0.12
Case 46	Radial	Ceiling	15	18.8	65.8	0.12
Case 71	Low Ind	High x4 / Low x4	15	18.8	65.8	0.12
Case 05	Slot	High	15	18.8	65.8	0.12
Case 41	Slot	Ceiling x4	15	18.8	65.8	0.12
Case 11	Radial	Low	15	20.7	69.3	0.12
Case 57	Radial	Low	15	18.8	65.8	0.13
Case 75	Radial	Ceiling/Low 50/50	15	18.8	65.8	0.13
Case 77	Slot	Ceiling	15	18.8	65.8	0.13
Case 14	Low Ind	Ceiling	15	20.7	69.3	0.14
Case 22	Radial	Low	15	18.8	65.8	0.14
Case 89	Low Ind	Low	15	19.2	66.6	0.14
Case 50	Radial	Ceiling	15	18.8	65.8	0.14
Case 37	Radial	Ceiling/Low 50/50	15	18.8	65.8	0.14
Case 23	Slot	Low	15	18.8	65.8	0.14
Case 45	Radial	Ceiling	15	18.8	65.8	0.14
Case 49	Radial	Ceiling	15	18.8	65.8	0.14
Case 30	Low Ind	Low	20	19.8	67.6	0.14
Case 03	Radial	Low	15	18.8	65.8	0.14
Case 76	Radial	Ceiling	15	18.8	65.8	0.14
Case 91	Slot	Ceiling	15	18.8	65.8	0.14
Case 78	Low Ind	Ceiling	15	18.8	65.8	0.15
Case 38	Slot	Ceiling/Low 50/50	15	18.8	65.8	0.15
Case 04	Slot	Ceiling	15	18.8	65.8	0.15
Case 02	Radial	High	15	18.8	65.8	0.15
Case 42	Low Ind	Ceiling x4	15	18.8	65.8	0.16
Case 58	Slot	High	15	18.8	65.8	0.16
Case 19	Radial	Ceiling	15	18.8	65.8	0.16
Case 61	Low Ind	Low	15	18.8	65.8	0.16
Case 26	Slot	Ceiling	15	18.8	65.8	0.16
Case 06	Slot	Low	15	18.8	65.8	0.16
Case 21	Low Ind	Ceiling	15	18.8	65.8	0.16
Case 07	Low Ind	Ceiling	15	18.8	65.8	0.16
Case 08	Low Ind	High	15	18.8	65.8	0.16
Case 54	Slot	Ceiling	15	18.8	65.8	0.17
Case 43	Low Ind (rot 90°)	Ceiling	15	18.8	65.8	0.17
Case 55	Low Ind	Ceiling	15	18.8	65.8	0.17
Case 52	Radial	Ceiling	15	18.8	65.8	0.18

Case Name	Supply Diffuser Type	Exhaust Location and Number	Supply ACH	Supply Temperature (°C)	Supply Temperature (°F)	Room NH ₃ (day 4) (ppm)
Case 39	Low Ind	Ceiling/Low 50/50	15	18.8	65.8	0.18
Case 90	Radial	Ceiling	15	18.8	65.8	0.18
Case 60	Low Ind	High	15	18.8	65.8	0.18
Case 95	Low Ind	Ceiling	15	17.5	63.5	0.18
Case 20	Slot	Ceiling	15	18.8	65.8	0.18
Case 79	Radial	2 Door exhausts	15	18.8	65.8	0.18
Case 24	Low Ind	Low	15	18.8	65.8	0.18
Case 56	Radial	High	15	18.8	65.8	0.18
Case 48	Radial	Ceiling	15	18.8	65.8	0.18
Case 51	Radial	Ceiling	15	18.8	65.8	0.18
Case 53	Radial	Ceiling	15	18.8	65.8	0.18
Case 09	Low Ind	Low	15	18.8	65.8	0.20
Case 81	Low Ind	2 Door exhausts	15	18.8	65.8	0.20
Case 17	Slot	Ceiling	15	18.8	65.8	0.20
Case 80	Slot	2 Door exhausts	15	18.8	65.8	0.20
Case 18	Low Ind	Ceiling	15	18.8	65.8	0.20
Case 68	Low Ind	Low	20	18.9	66.0	0.21
Case 64	Low Ind	Low	20	18.9	66.0	0.21
Case 44	Radial (rot 90°)	Ceiling	15	18.8	65.8	0.21
Case 25	Radial	Ceiling	15	18.8	65.8	0.22
Case 98	Low ind	Ceiling	15	17.5	63.5	0.23
Case 93	Radial	Ceiling	15	17.5	63.5	0.24
Case 27	Low Ind	Ceiling	15	18.8	65.8	0.24
Case 31	Radial	Low	15	17.5	63.5	0.24
Case 28	Low Ind	Low	10	16.8	62.2	0.25
Case 82	Radial	2 Door exhausts	15	18.8	65.8	0.27
Case 32	Slot	Low	15	17.5	63.5	0.28
Case 96	Radial	Ceiling	15	17.5	63.5	0.28
Case 97	Slot	Ceiling	15	17.5	63.5	0.29
Case 86	Slot	Low	15	17.5	63.5	0.29
Case 94	Slot	Ceiling	15	17.5	63.5	0.31
Case 29	Low Ind	Low	5	11	51.8	0.32
Case 33	Low Ind	Low	15	17.5	63.5	0.32
Case 85	Radial	Low	15	17.5	63.5	0.33
Case 65	Low Ind	Low	15	17.5	63.5	0.33
Case 35	Slot	Ceiling	15	17.5	63.5	0.34
Case 84	Low Ind	2 Door exhausts	15	17.5	63.5	0.34
Case 36	Low Ind	Ceiling	15	17.5	63.5	0.39
Case 34	Radial	Ceiling	15	17.5	63.5	0.41
Case 83	Slot	2 Door exhausts	15	17.5	63.5	0.49
Case 67	Low Ind	Low	10	14.8	58.6	0.57
Case 63	Low Ind	Low	10	14.8	58.6	0.58
Case 66	Low Ind	Low	5	6.6	43.9	0.72
Case 62	Low Ind	Low	5	6.6	43.9	0.77

Table 3.08 Ranking of Cases with respect to Cage NH₃ (Day 4)

Case Name	Supply Diffuser Type	Exhaust Location and Number	Supply ACH	Supply Temperature (°C)	Supply Temperature (°F)	Cage NH ₃ (day 4) (ppm)
Case 87	Radial	Low	15	19.2	66.6	3.13
Case 88	Slot	Low	15	19.2	66.6	3.49
Case 03	Radial	Low	15	18.8	65.8	3.53
Case 89	Low Ind	Low	15	19.2	66.6	3.68
Case 79	Radial	2 Door exhausts	15	18.8	65.8	3.70
Case 23	Slot	Low	15	18.8	65.8	3.71
Case 06	Slot	Low	15	18.8	65.8	3.72
Case 30	Low Ind	Low	20	19.8	67.6	3.75
Case 22	Radial	Low	15	18.8	65.8	3.77
Case 80	Slot	2 Door exhausts	15	18.8	65.8	3.84
Case 09	Low Ind	Low	15	18.8	65.8	3.88
Case 81	Low Ind	2 Door exhausts	15	18.8	65.8	3.92
Case 82	Radial	2 Door exhausts	15	18.8	65.8	3.92
Case 32	Slot	Low	15	17.5	63.5	3.93
Case 28	Low Ind	Low	10	16.8	62.2	3.93
Case 69	Radial	High x4 / Low x4	15	18.8	65.8	3.94
Case 29	Low Ind	Low	5	11	51.8	3.97
Case 92	Low Ind	Ceiling	15	18.8	65.8	4.02
Case 02	Radial	High	15	18.8	65.8	4.03
Case 20	Slot	Ceiling	15	18.8	65.8	4.04
Case 41	Slot	Ceiling x4	15	18.8	65.8	4.06
Case 64	Low Ind	Low	20	18.9	66.0	4.07
Case 37	Radial	Ceiling/Low 50/50	15	18.8	65.8	4.13
Case 68	Low Ind	Low	20	18.9	66.0	4.13
Case 84	Low Ind	2 Door exhausts	15	17.5	63.5	4.17
Case 57	Radial	Low	15	18.8	65.8	4.17
Case 04	Slot	Ceiling	15	18.8	65.8	4.18
Case 72	Radial	High x4 / Low x2	15	18.8	65.8	4.22
Case 90	Radial	Ceiling	15	18.8	65.8	4.22
Case 05	Slot	High	15	18.8	65.8	4.23
Case 24	Low Ind	Low	15	18.8	65.8	4.24
Case 42	Low Ind	Ceiling x4	15	18.8	65.8	4.25
Case 38	Slot	Ceiling/Low 50/50	15	18.8	65.8	4.28
Case 91	Slot	Ceiling	15	18.8	65.8	4.33
Case 33	Low Ind	Low	15	17.5	63.5	4.44
Case 31	Radial	Low	15	17.5	63.5	4.45
Case 52	Radial	Ceiling	15	18.8	65.8	4.49
Case 74	Low Ind	High x4 / Low x2	15	18.8	65.8	4.53
Case 97	Slot	Ceiling	15	17.5	63.5	4.54
Case 86	Slot	Low	15	17.5	63.5	4.54
Case 71	Low Ind	High x4 / Low x4	15	18.8	65.8	4.56
Case 58	Slot	High	15	18.8	65.8	4.58
Case 39	Low Ind	Ceiling/Low 50/50	15	18.8	65.8	4.58
Case 70	Slot	High x4 / Low x4	15	18.8	65.8	4.58
Case 19	Radial	Ceiling	15	18.8	65.8	4.61
Case 18	Low Ind	Ceiling	15	18.8	65.8	4.62
Case 94	Slot	Ceiling	15	17.5	63.5	4.66
Case 17	Slot	Ceiling	15	18.8	65.8	4.71
Case 61	Low Ind	Low	15	18.8	65.8	4.73
Case 21	Low Ind	Ceiling	15	18.8	65.8	4.73
Case 50	Radial	Ceiling	15	18.8	65.8	4.73
Case 85	Radial	Low	15	17.5	63.5	4.76
Case 95	Low Ind	Ceiling	15	17.5	63.5	4.77

Case Name	Supply Diffuser Type	Exhaust Location and Number	Supply ACH	Supply Temperature (°C)	Supply Temperature (°F)	Cage NH ₃ (day 4) (ppm)
Case 08	Low Ind	High	15	18.8	65.8	4.83
Case 76	Radial	Ceiling	15	18.8	65.8	4.85
Case 73	Slot	High x4 / Low x2	15	18.8	65.8	4.87
Case 65	Low Ind	Low	15	17.5	63.5	4.90
Case 35	Slot	Ceiling	15	17.5	63.5	4.90
Case 77	Slot	Ceiling	15	18.8	65.8	4.94
Case 10	Radial	Ceiling	15	20.7	69.3	4.94
Case 15	Low Ind	Low	15	20.7	69.3	4.94
Case 43	Low Ind (rot 90°)	Ceiling	15	18.8	65.8	4.96
Case 93	Radial	Ceiling	15	17.5	63.5	4.97
Case 75	Radial	Ceiling/Low 50/50	15	18.8	65.8	4.98
Case 56	Radial	High	15	18.8	65.8	5.01
Case 83	Slot	2 Door exhausts	15	17.5	63.5	5.15
Case 78	Low Ind	Ceiling	15	18.8	65.8	5.16
Case 66	Low Ind	Low	5	6.6	43.9	5.21
Case 45	Radial	Ceiling	15	18.8	65.8	5.22
Case 62	Low Ind	Low	5	6.6	43.9	5.23
Case 54	Slot	Ceiling	15	18.8	65.8	5.32
Case 40	Radial	Ceiling x4	15	18.8	65.8	5.33
Case 46	Radial	Ceiling	15	18.8	65.8	5.35
Case 47	Radial	Ceiling	15	18.8	65.8	5.36
Case 11	Radial	Low	15	20.7	69.3	5.42
Case 36	Low Ind	Ceiling	15	17.5	63.5	5.44
Case 98	Low ind	Ceiling	15	17.5	63.5	5.50
Case 96	Radial	Ceiling	15	17.5	63.5	5.51
Case 49	Radial	Ceiling	15	18.8	65.8	5.56
Case 51	Radial	Ceiling	15	18.8	65.8	5.64
Case 63	Low Ind	Low	10	14.8	58.6	5.64
Case 12	Slot	Ceiling	15	20.7	69.3	5.66
Case 34	Radial	Ceiling	15	17.5	63.5	5.66
Case 16	Radial	Ceiling	15	18.8	65.8	5.76
Case 14	Low Ind	Ceiling	15	20.7	69.3	5.82
Case 48	Radial	Ceiling	15	18.8	65.8	5.98
Case 44	Radial (rot 90°)	Ceiling	15	18.8	65.8	6.03
Case 67	Low Ind	Low	10	14.8	58.6	6.03
Case 55	Low Ind	Ceiling	15	18.8	65.8	6.22
Basecase	Radial	Ceiling	15	18.8	65.8	6.33
Case 59	Slot	Low	15	18.8	65.8	6.38
Case 07	Low Ind	Ceiling	15	18.8	65.8	6.71
Case 53	Radial	Ceiling	15	18.8	65.8	7.02
Case 13	Slot	Low	15	20.7	69.3	7.21
Case 60	Low Ind	High	15	18.8	65.8	7.56
Case 25	Radial	Ceiling	15	18.8	65.8	11.05
Case 27	Low Ind	Ceiling	15	18.8	65.8	12.31
Case 26	Slot	Ceiling	15	18.8	65.8	18.42

