

Chapter 6

Improvement of the rubber smoking room

6.1 Introduction

The rationale of this study is non-uniformity problem of temperature and velocity distributions in the model rubber smoking room; temperature variation which is as large as 15°C. To improve the temperature and velocity distributions, effects of size, position and number of gas supply ducts, and ventilating lids need to be studied. The boundary conditions and grid setting for all model rooms in this study are identical to the previous model room. In the discussions for all case studies in this chapter, temperature contours, velocity patterns and temperatures at 81 positions in the smoking room are compared to obtain a prototype of the rubber smoking room.

In this chapter, the case studies are separately presented into four main topics. First, study on the effects of size and number of gas supply ducts is presented. Second, study on the effects of size, positions and number of ventilation lids is presented. Next, study on the combined effects of number of the gas supply ducts and size and position of ventilating lids is presented. Finally, adjustment of heat supply rate to increase efficiency is investigated. Suggestions about applications of this model in the smoking process will be explained.

A prototype of the rubber smoking room will be a target for entrepreneur groups who want to construct a new rubber smoking room.

6.2 Effects of size and number of gas supply ducts

The aim of this study is to distribute the hot gas inlet into all gas supply ducts at the floor of the smoking room. The standard sizes for the hot gas ducts are 4, 3, 2 and 1 inch-diameter. The suitable number of gas supply ducts for each size was investigated.

From primary investigation, result of some case studies showed circulation of hot gas between the smoking room and the gas supply cavity. This was the result of using excessive number of gas supply ducts. For example, the case study of using seventy five 4 inch-diameter ducts for hot gas supply showed that the hot gas flowed to the smoking room from the rear side ducts and recirculated into the gas supply cavity through the ducts at the front part of the room as shown in Fig. 6.1.

In contrast, using insufficient gas supply ducts resulted in non-uniform temperature and velocity distributions of hot gas within the smoking room, as in the case of the present rubber smoking room that used twelve 4 inch-diameter supply ducts.

When using 1 inch-diameter gas supply ducts, the total number of grids of the model room is as many as 2 million cells and it resulted in excessive calculation time. Moreover, this size of the duct is too small for convenience in construction and it is easy to be clogged with the accumulation of smoke particles collected on its surface. Therefore, in all of next cases studied, only 2 inch-diameter ducts would be used for supplying hot gas into the smoking room.

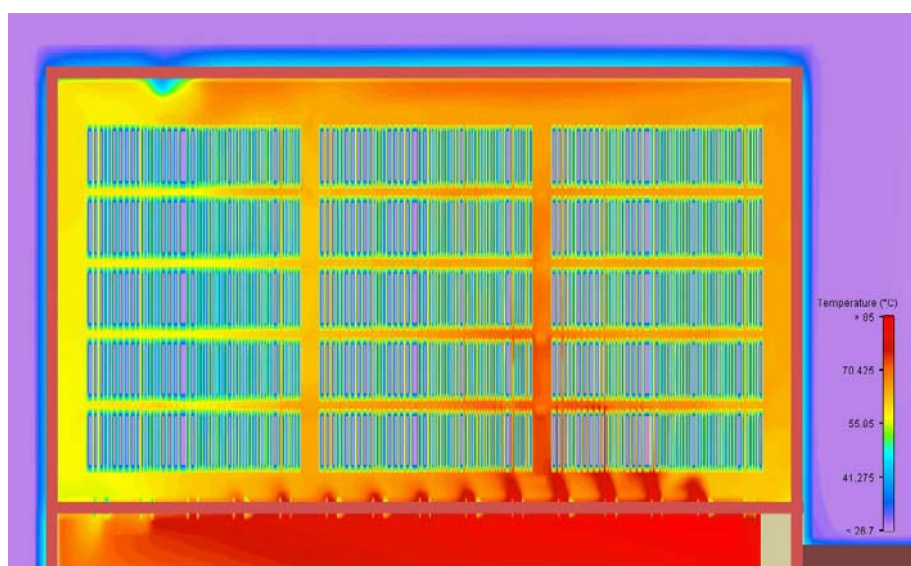


Figure 6.1 Temperature contour on the left plane of the example case study.

Case 1

1. Structure details

In this case, one hundred and ninety two gas supply ducts with diameter of two inches were used. Positions of the gas supply ducts are shown in Fig. 6.2. The size and positions of ventilating lids of the model room remained unaltered from the present rubber smoking room discussed in Chapter 5.

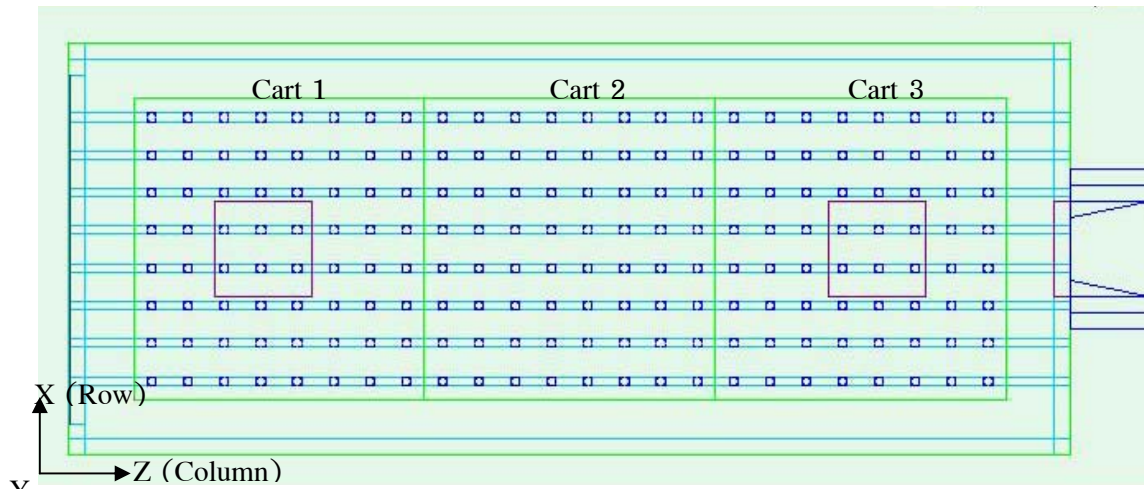


Figure 6.2 Positions of the gas supply ducts and ventilating lids for the case 1 shown from the top view.

2. Results and discussion

Flow pattern

Flow pattern at the right, middle and left planes are shown in Figs. 6.3, 6.4 and 6.5, respectively. The figures of the right and left planes show that high velocity occurs at the rear part of the smoking room. The figure of the middle plane shows that there are hot gas flowing out the room from the ventilating lid near the rear part of the room, and the back-flow of outside air into the room through the ventilating lid near the front part of the room as in the case in Chapter 5.

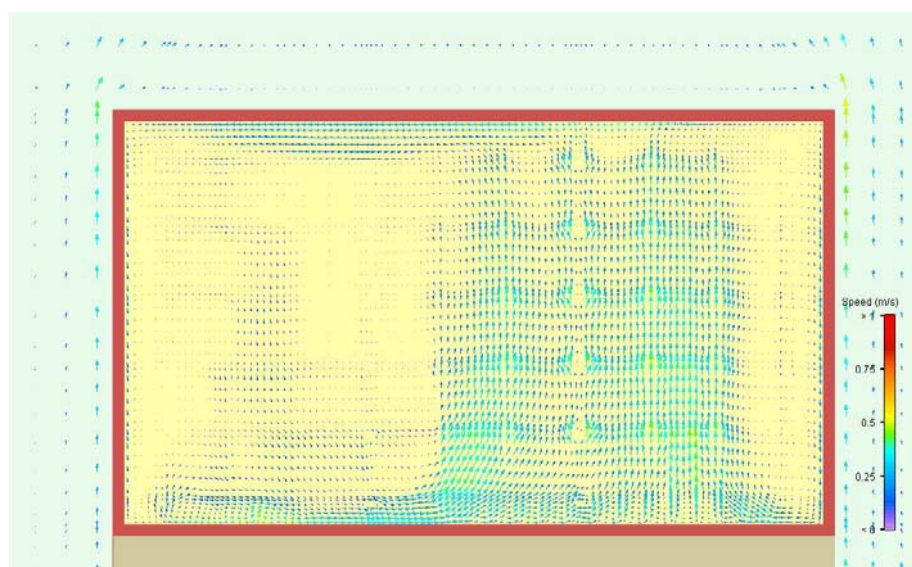


Figure 6.3 Flow pattern on the right plane of the case 1.

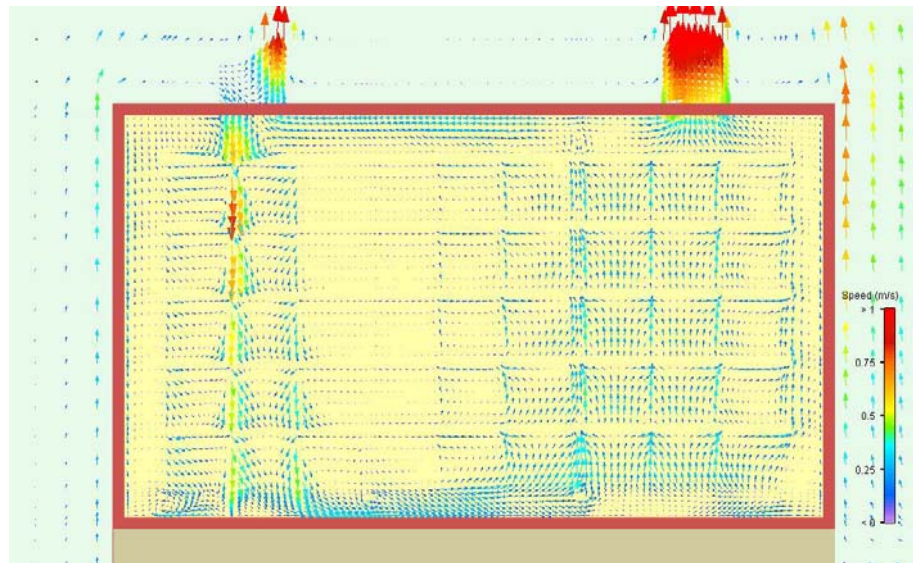


Figure 6.4 Flow pattern on the middle plane of the case 1.

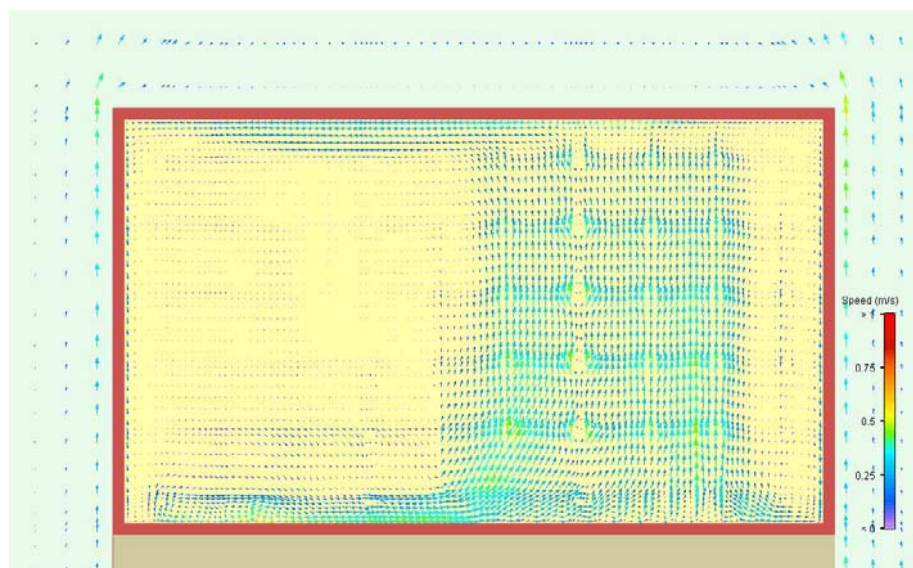


Figure 6.5 Flow pattern on the left plane of the case 1.

Temperature

Temperature contours of the right, middle and left planes are shown in Figs. 6.6, 6.7 and 6.8, respectively. All figures show high temperature regions taking place in the rear part along the length of the smoking room, particularly on the middle plane. This results from the fact that most of hot gas enters the smoking room through the ducts located in the rear part.

The low temperature regions take place in the space below the front ventilating lid. This may also be the result from outside air flowing into the room at the front ventilating lid as can be seen from the temperature contour in Fig. 6.7.

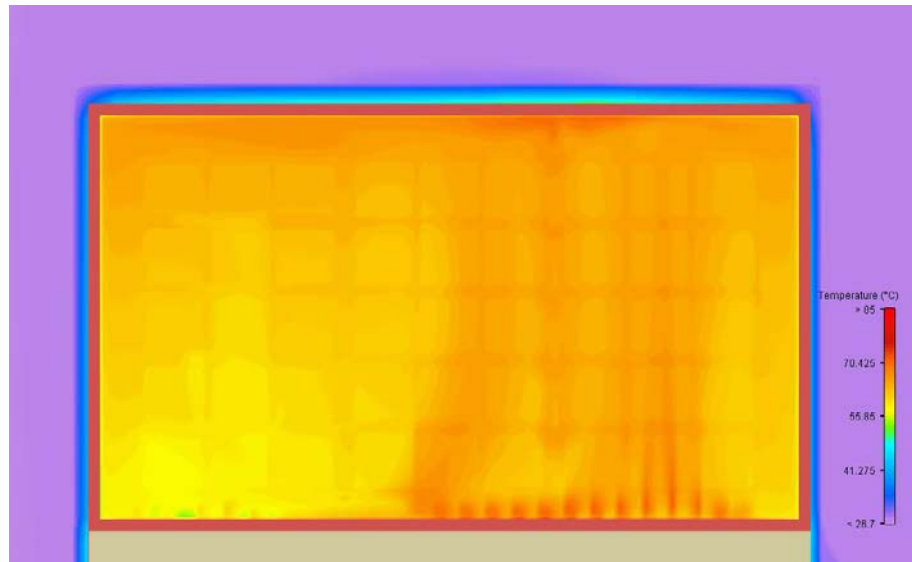


Figure 6.6 Temperature contour on the right plane of the case 1.

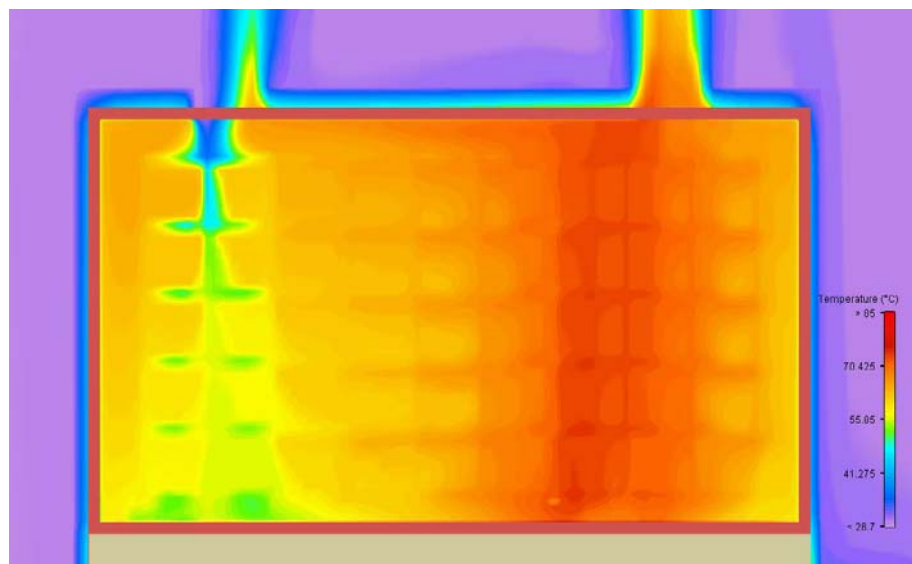


Figure 6.7 Temperature contour on the middle plane of the case 1.

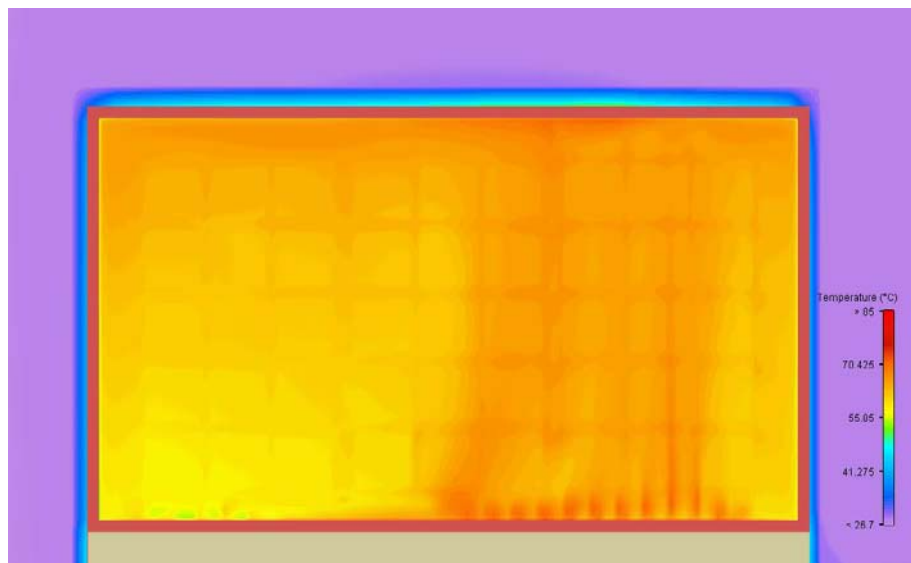


Figure 6.8 Temperature contour on the left plane of the case 1.

The temperature representation in the room has been obtained from the 81 positions in the simulation as described in chapter 5 (Fig. 5.3). Investigation of the temperature results shows that temperatures at 27 positions on the middle plane are between 57–74°C. Temperatures at 27 positions on the right plane range from 58–67°C. Also, temperatures at 27 positions on the left plane are between 58–67°C. The results show the symmetry behavior of gas supply duct positions on the x-axis as shown in Fig. 5.3. Details of the temperature at 81 positions in the smoking room are given in Appendix B2.

Due to symmetrical behavior of the room, only the temperature contours and flow patterns of the right and middle planes will be presented in the following cases. Because the temperature in the region of the rear part of the smoking room is excessively high, the number of gas supply ducts in the rear part needs to be reduced.

Case 2

Structure details

In this case, two rows of gas supply ducts under cart 2 and cart 3 positions were removed, since the hot gas seems to flow excessively through the rear part. One hundred and sixty gas supply ducts were used. All the ducts were still evenly distributed along the x-axis in the room. Positions of the modified gas supply ducts are shown in Fig. 6.9. Size and positions of the ventilating lids of this model room, again, remained unaltered.

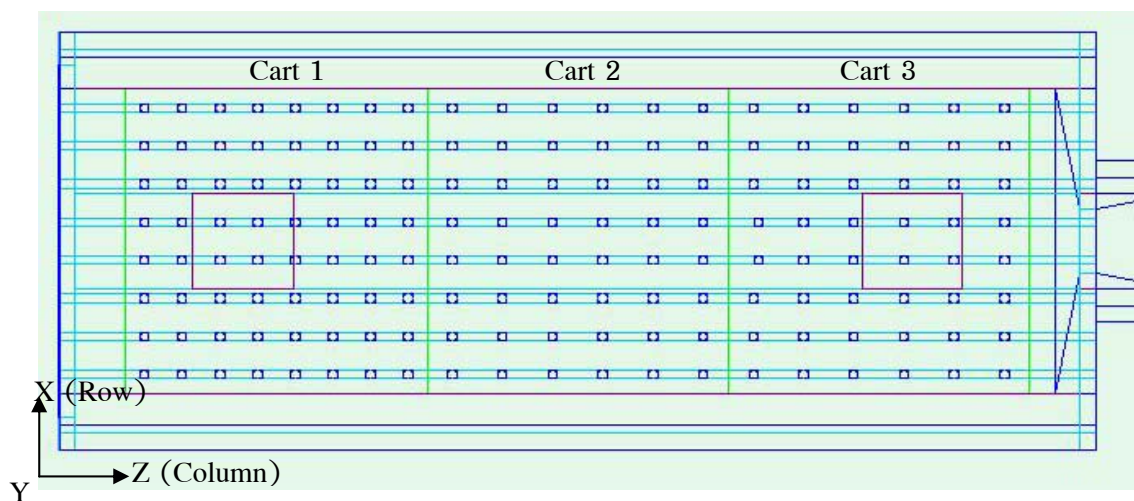


Figure 6.9 Positions of the gas supply ducts and the ventilating lids of the case 2 shown from the top view.

2. Results and discussion

Flow pattern

Flow patterns of the right and middle planes of the model room are shown in Figs. 6.10 and 6.11, respectively. It can be seen that high velocity on the right plane occurs at the middle part of the smoking room. At the middle plane, it can also be seen that all hot gas flows out of the smoking room through both ventilating lids. However, a minor portion of outside air sneaks into the smoking room through the rear ventilating lid.

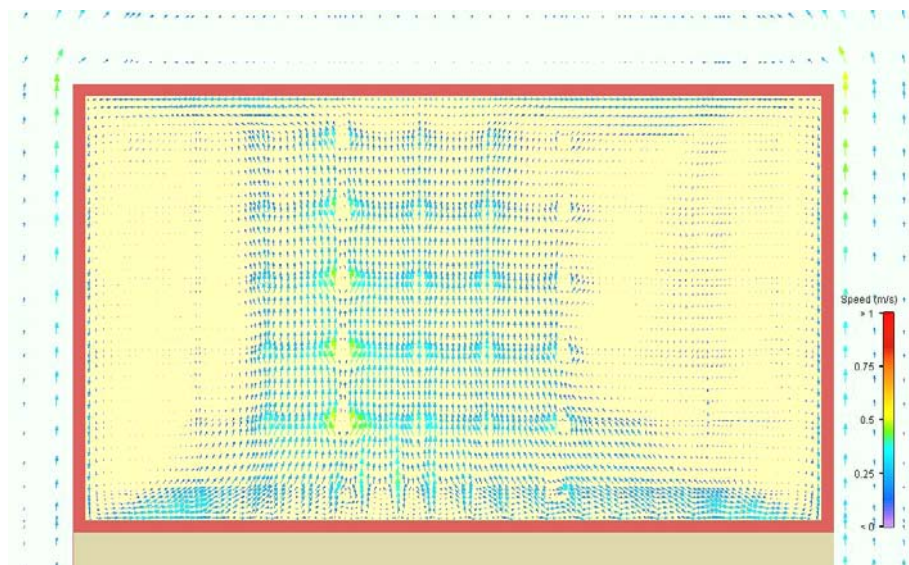


Figure 6.10 Flow pattern on the right plane of the case 2.

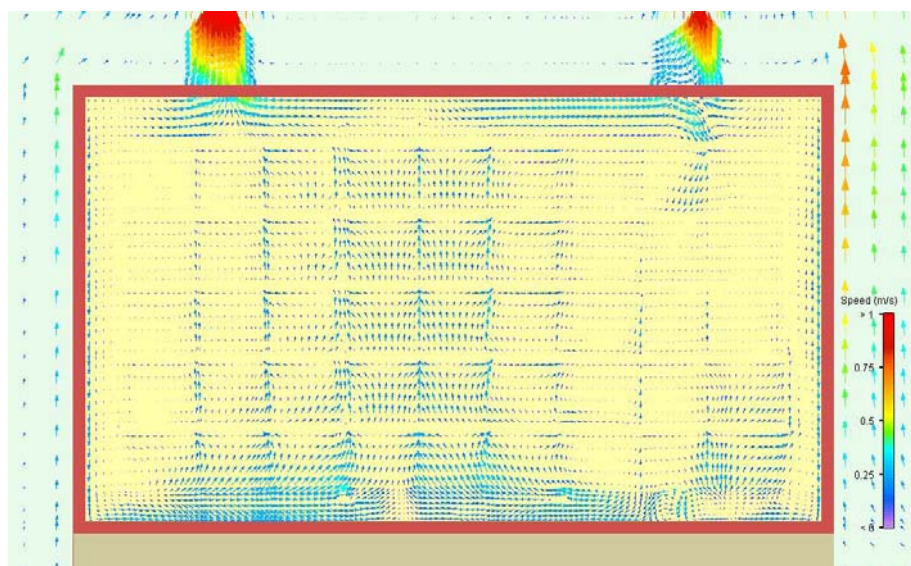


Figure 6.11 Flow pattern on the middle plane of the case 2.

Temperature

Temperature contours of the right and middle planes of the model room are shown in Figs. 6.12 and 6.13, respectively. It can be seen that high temperature region takes place at the middle part along the length of the smoking room, particularly, on the middle plane. This may result from the fact that most of hot gas from the inlet ducts entered the smoking room through the middle part of the room. On the other hand, low temperature takes place in the region below the rear ventilating lid. This could be caused by the back-flow of outside air entering the room through the rear ventilating lid.

Investigation of the temperature results shows that temperatures at 27 positions on the right plane range from 65–70°C. Temperatures on the middle plane are between 67–74°C. Details of temperatures at 54 positions in the smoking room are given in Appendix B3.

Comparison of the results between this case and the case 1 shows that the average temperature of this model room is higher, but the temperature variation in the room is smaller. This may be because this model can be used to move the hot gas forward to the front part of the smoking room and most of hot gas flows out the room. Therefore, this model gives more qualitative improvement than the previous model.

However, this model gives only a uniform flow on the middle plane of the smoking room but the temperatures in the region of the middle part of the smoking room are excessively high. This may result from poor ventilation of hot gas out of the room from the outlet. Therefore, the suitable number and size of the ventilating lids at the ceiling need to be studied.

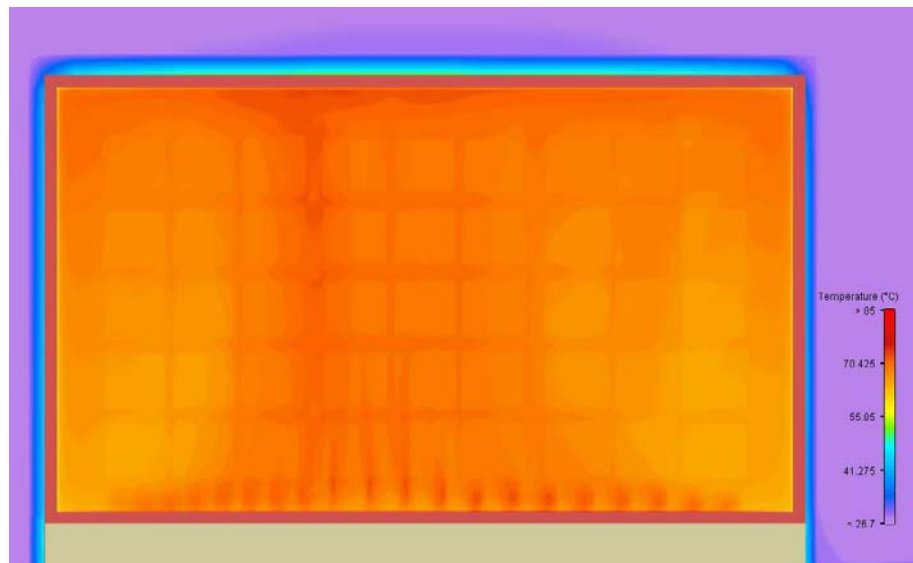


Figure 6.12 Temperature contour on the right plane of the case 2.

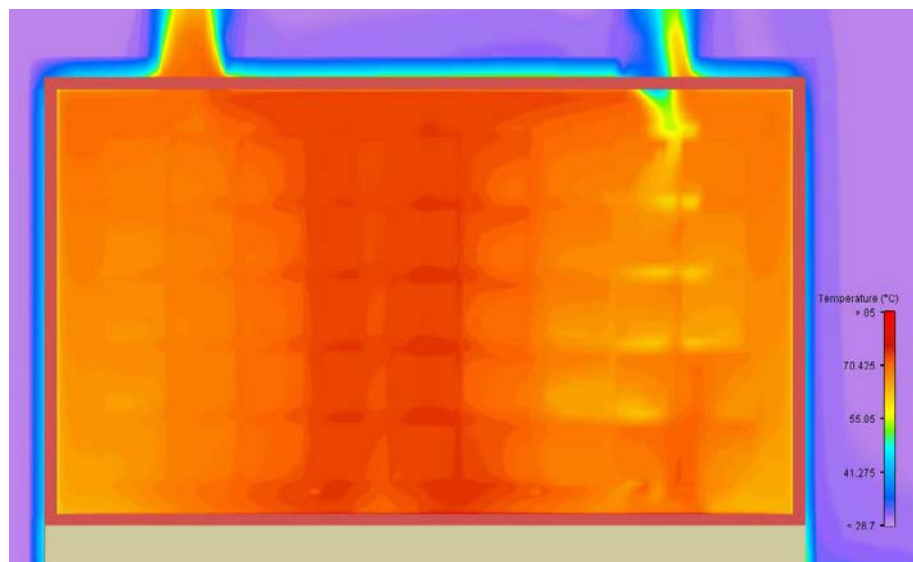


Figure 6.13 Temperature contour on the middle plane of the case 2.

6.3 Effects of size, position and number of ventilating lids

Velocity distributions on the right and middle planes of the previous studies are still non-uniform although there is improvement of temperature distribution. Therefore, suitable size, position and number of the ventilating lids for air ventilating need to be investigated. In this study, the model room of case 2 in which the flow was improved by modification of the size and number of the gas supply ducts will be modified by adjusting the ventilating lids at the ceiling.

This study began by distributing many small ventilating lids to cover the ceiling area. The total area of the ventilating lids remained nearly unchanged from the previous cases. Next, the number and size of the ventilating lids were reduced. Finally, the model room with minimum number and suitable position of the ventilating lids will be introduced for the next study.

Case 3

Structure details

In this case, 27 ventilating lids with the size of $10\text{ cm} \times 10\text{ cm}$ were used to replace the original 2 ventilating lids of the size $60\text{ cm} \times 60\text{ cm}$. These ventilating lids were evenly distributed into 3 rows as shown in Fig. 6.14. Each cart area contains 9 ventilating lids. One hundred and fifty six gas supply ducts were used.

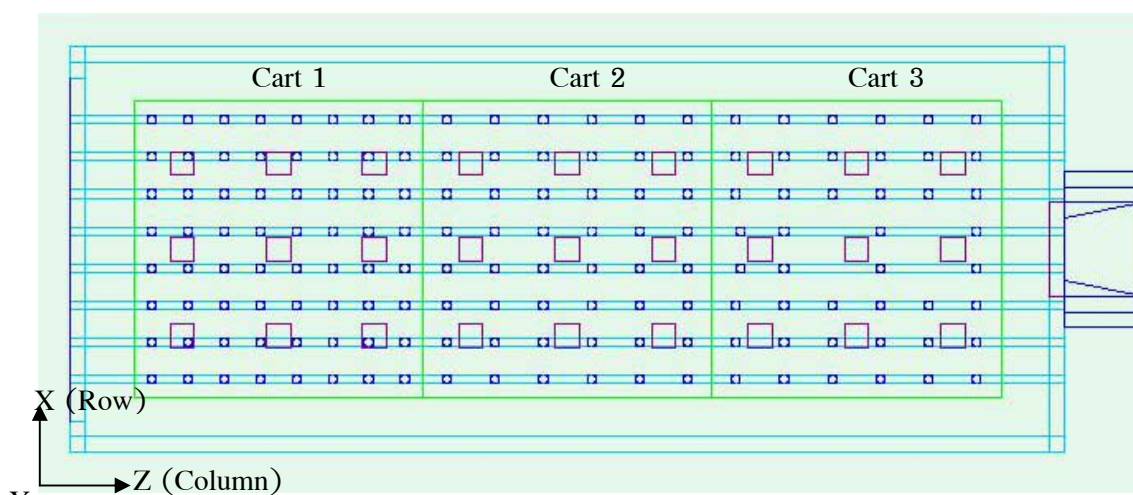


Figure 6.14 Positions of ventilating lids and gas supply ducts of case 3 shown from the top view.

Four gas supply ducts of the two middle rows in the rear part of the smoking room were removed from the preceding case to reduce excessive gas flow into the rear part. The positions of the gas supply ducts are shown in Fig. 6.14

2. Results and discussion

Flow pattern

Flow patterns at the right and middle planes of the model room are shown in Figs. 6.15 and Fig. 6.16, respectively. At the right plane, it can be seen that high velocity occurs in two regions; one in the front part and the other in the middle of the room. The hot gas flows out through both ventilating lids except the first lid on the side rows and first two lids on the middle rows.

Velocity of the hot gas at the middle plane was lower than that at the right plane. This may be the result from the influence of the ventilating lid positions of the middle row which were not situated directly above the hot gas ducts as shown in Fig.6.14. Moreover, it can be seen that removal of 4 gas supply ducts does not show significant effect on the velocity.

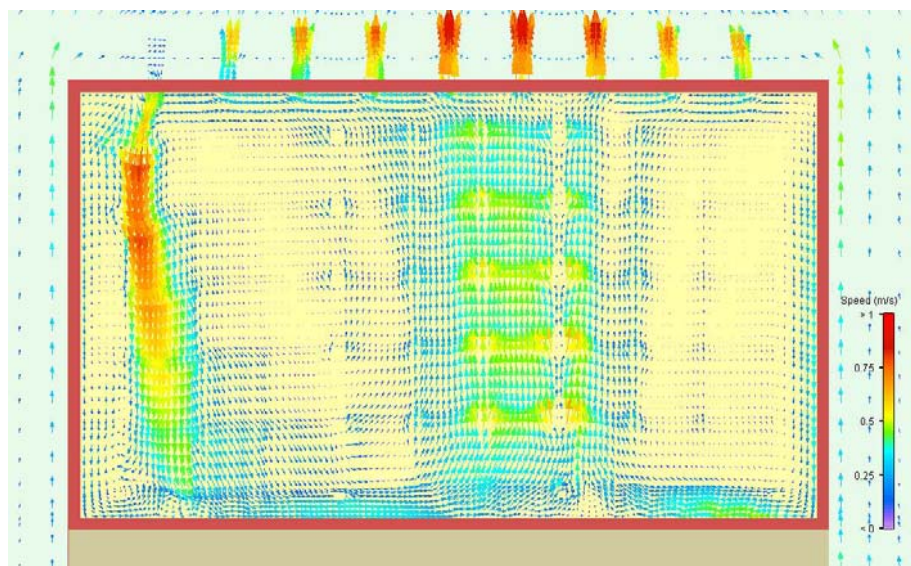


Figure 6.15 Flow pattern on the right plane of the case 3.

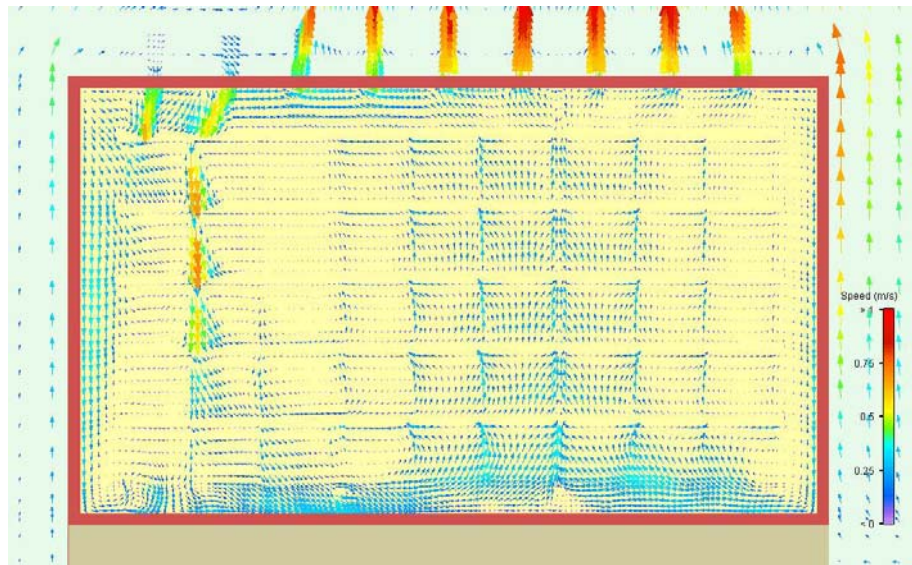


Figure 6.16 Flow pattern on the middle plane of the case 3.

Temperature

Temperature contours of the right and middle planes of the model room are shown in Figs. 6.17 and 6.18, respectively. Temperature is particularly high in the middle part of the model room as in the preceding case. This is the result of high gas flow from the ducts situated in the middle part of the room as shown in the flow pattern figures.

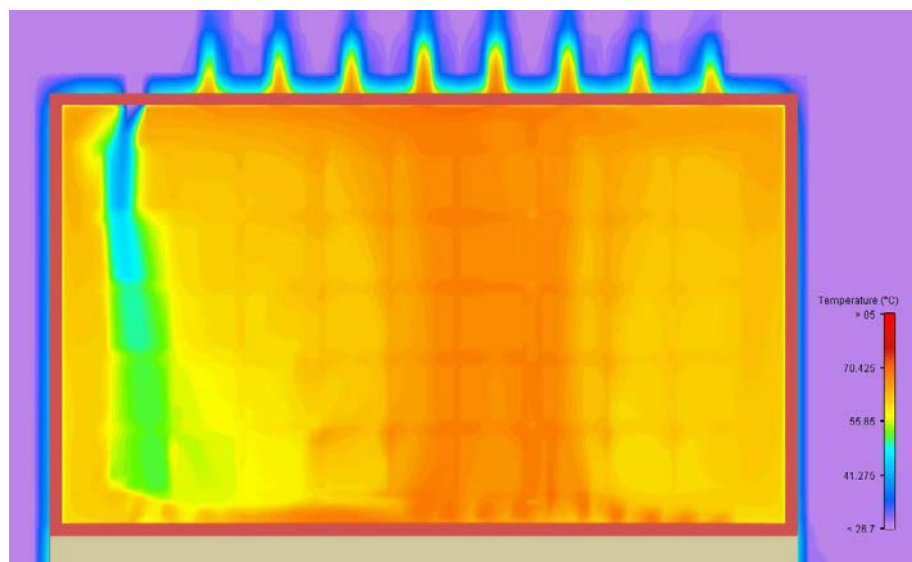


Figure 6.17 Temperature contour on the right plane of the case 3.

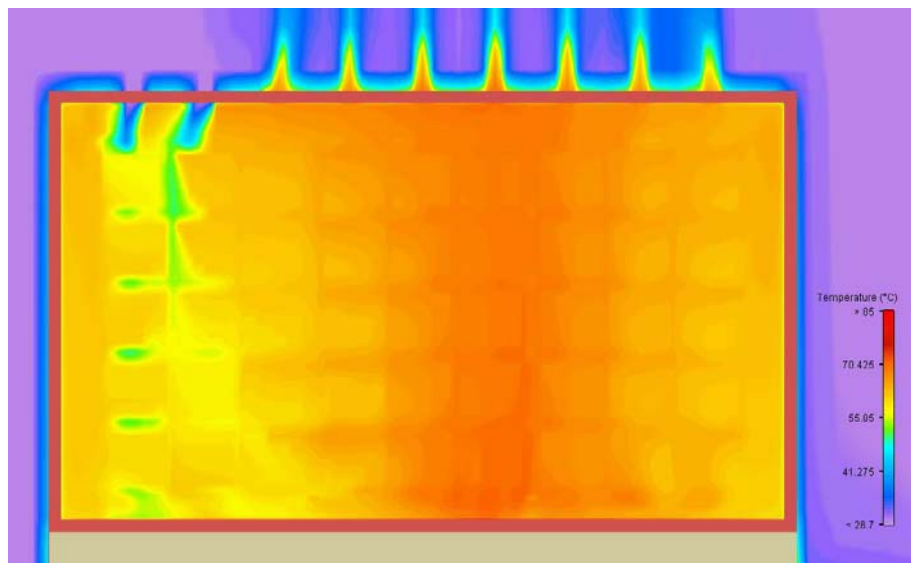


Figure 6.18 Temperature contour on the middle plane of the case 3.

Temperature contour on the middle plane differs slightly from that on the right plane. At the right plane, low temperature takes the place only below the first ventilating lid at the front part as shown in Fig.6.17. But at the middle plane, low temperature takes place below first two ventilating lids at the front part of the smoking room as shown in Fig 6.18. This is because the quantity and velocity of the hot gas flowing out through the middle row of the ventilating lids are lower than those of the other rows. Therefore, back-flow into the room at the middle row was larger than the others rows.

Results from investigation of temperatures at 54 positions of the right and middle planes show that temperatures at the right plane are between 47–67°C, while temperatures at the middle plane are between 60–70°C. Details of temperatures at 54 positions of the right and middle planes are given in Appendix B4.

Temperature variation of this model room is as large as 20°C particularly on the right plane. This may be the result of excessive number of the ventilating lids. Therefore, in the next study, number of the ventilating lids will be reduced while their size will be enlarged. Moreover, their positions will be moved to obtain better results.

Case study 4

1. Structure details

In this simulation, 12 ventilating lids with the size of 25 cm × 25 cm were used. These ventilating lids are evenly separated into 2 rows and were symmetrical along the x-axis as shown in Fig. 6.19.

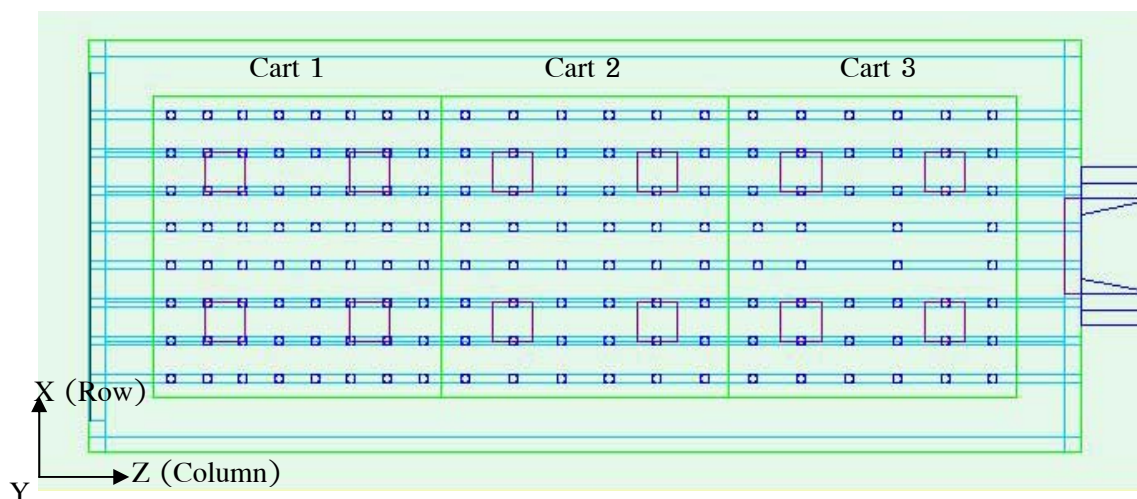


Figure 6.19 Positions of the ventilating lids and the gas supply ducts of case 4 shown from the top view.

2. Results and discussion

Flow pattern

Flow patterns at the right and middle planes of the model room are shown in Figs. 6.20 and 6.21, respectively. At the right plane, the high velocity regions take place at the front and the rear parts of the smoking room. Hot gas flows out of the room through the ventilating lids at the rear part while back-flow from outside of the room takes place via the ventilating lids at near the front part of the smoking room. However, high velocity at the middle plane takes place only at the rear part of the smoking room.

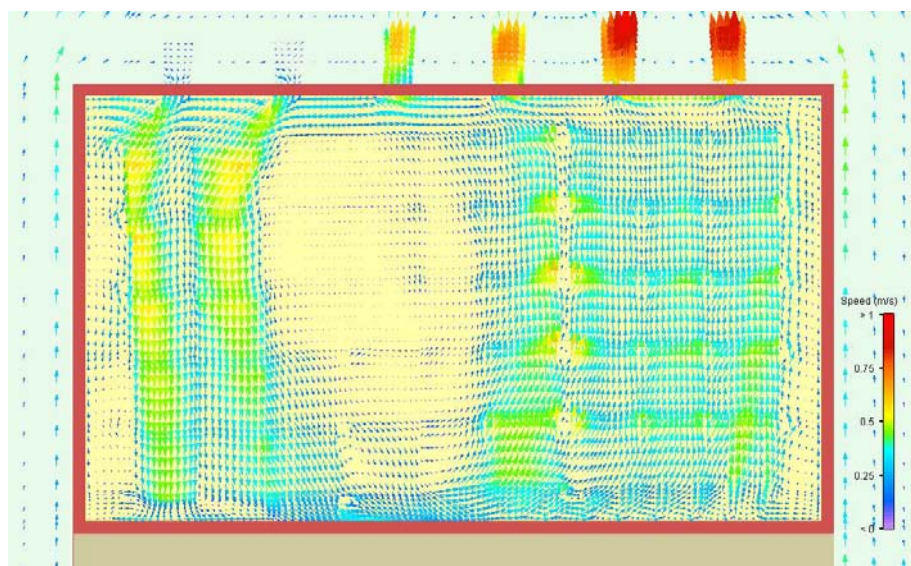


Figure 6.20 Flow pattern on the right plane of the case 4.

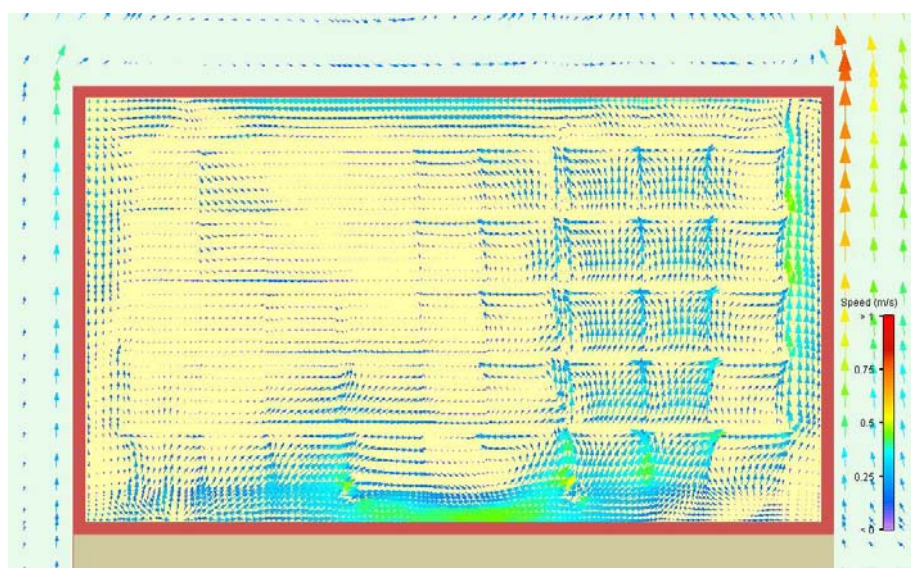


Figure 6.21 Flow pattern on the middle plane of the case 4.

Temperature

Temperature contours at the right and middle planes of the model room are shown in Figs. 6.22 and 6.23, respectively. At the right plane, low temperature takes place below the two ventilating lids at the front part of the smoking room. This may result from the back-flow of the outside air into the room as can be seen from the flow pattern. Similarly, at the middle plane, low temperature takes place in the same region as that at the right plane. High temperatures of the right and middle planes take place in the rear part of the

model room. This indicates the influence of the high velocity of hot gas inlet at the rear part of the smoking room.

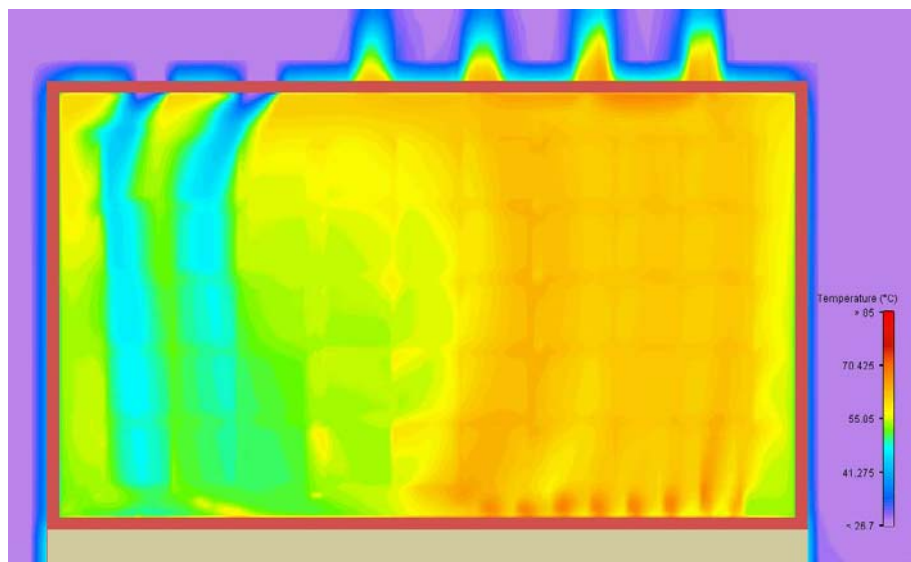


Figure 6.22 Temperature contour on the right plane of the case 4.

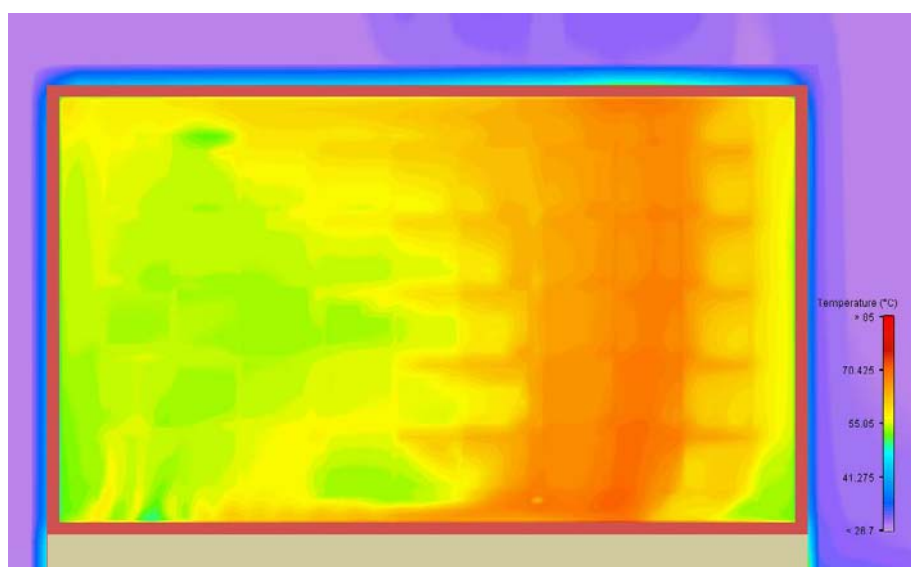


Figure 6.23 Temperature contour on the middle plane of the case 4.

Results from investigation of temperatures at 54 positions on the right and middle planes show that the temperatures at the right plane are between 46–64°C. Temperatures at the middle plane are between 55–70°C. Details of temperature at 54 positions are given in Appendix B5.

Temperature variation of this model room was as large as 18°C particularly on the right plane. This may be the result of excessive number of the ventilating lids as in the preceding case. Therefore, in the next study, the number of ventilating lids will be, again, reduced and the positions will also be modified to obtain better situations.

Case 5

1. Structure details

In this case study, 8 ventilating lids with the size of $25\text{ cm} \times 25\text{ cm}$ were used for venting gas at the ceiling. Two rows of 4 ventilating lids were placed as shown in Fig. 6.24. It is noted that the ventilating lids were placed toward the front part of the room leaving the rear part containing less number of the lids. Distance between the ventilating lids in the row along z-axis is 1.2 m. Moreover, one hundred and fifty eight gas supply ducts were used. Six gas supply ducts of two middle rows under cart were removed from the preceding case. One column of the gas supply ducts was added to the front part of the smoking room as also shown in Fig. 6.24.

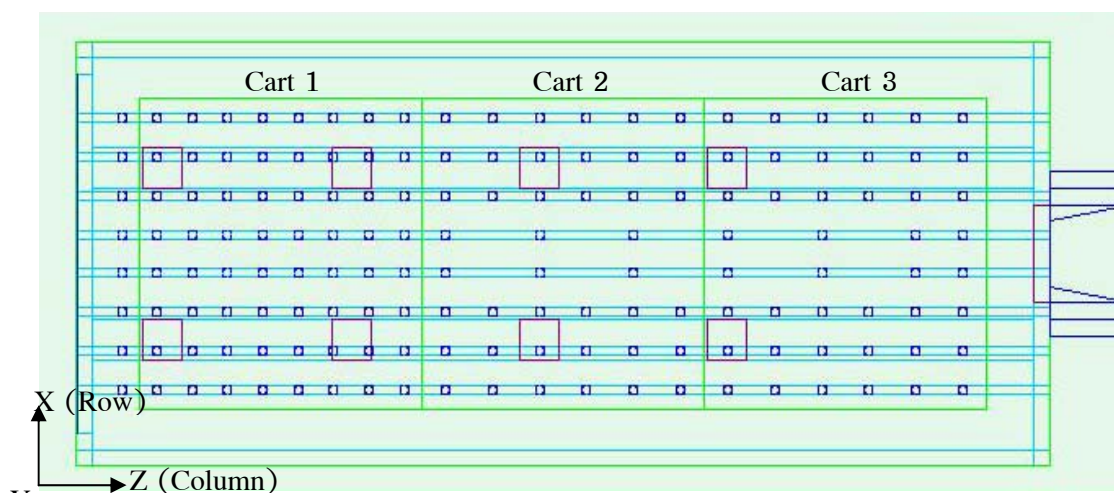


Figure 6.24 Positions of the ventilating lids and the gas supply ducts of the case 5 shown from the top view.

2. Results and discussion

Flow pattern

Flow patterns at the right and middle planes of the model room are shown in Figs. 6.25 and 6.26, respectively. At the right plane, the high velocity region takes place at the middle part of the smoking room.

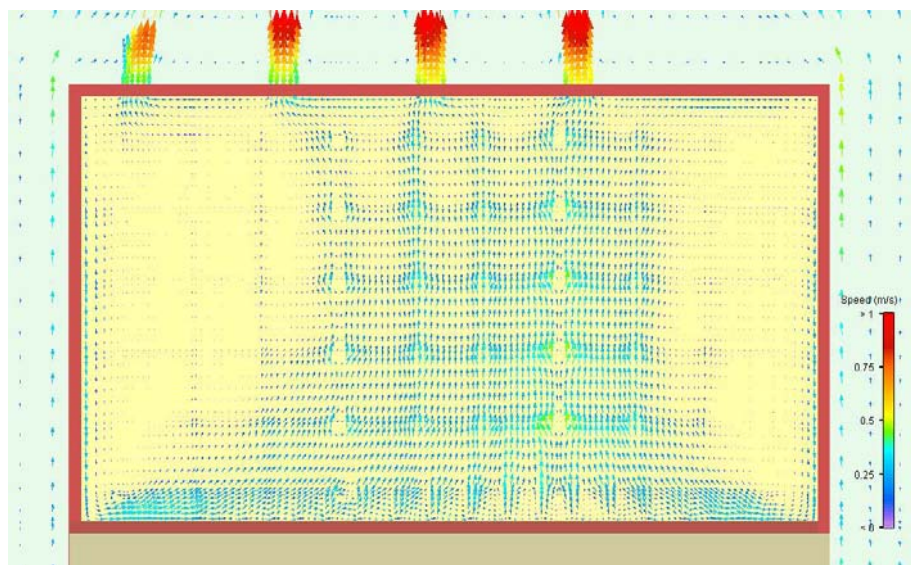


Figure 6.25 Flow pattern on the right plane of the case 5.

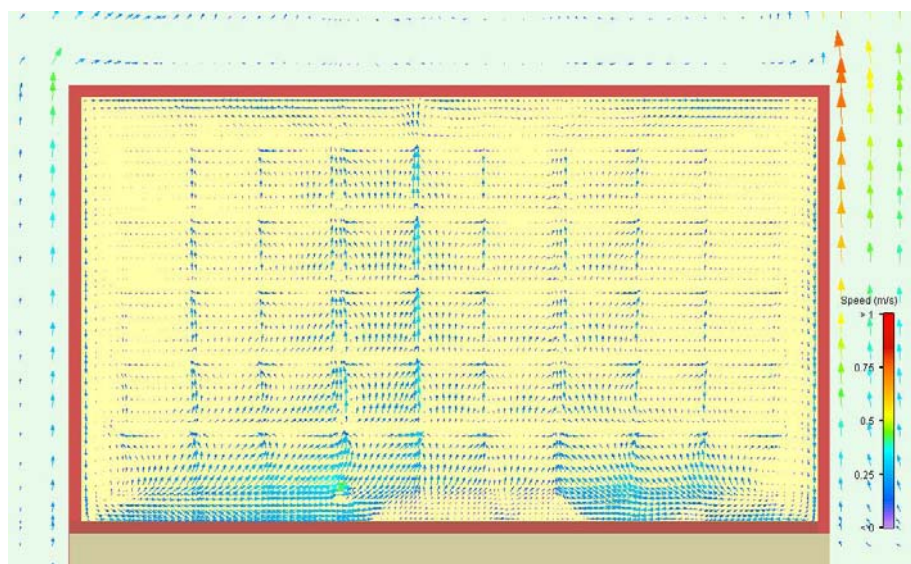


Figure 6.26 Flow pattern on the middle plane of the case 5.

Low velocity regions at the right plane take place at the front and rear parts of the model room. This may result from the influence of the ventilating lid positions which were shifted toward the front part of the room. However, velocity distribution at the middle plane is quite uniform.

Temperature

Temperature contours of the right and middle planes of the model room are shown in Figs. 6.27 and 6.28, respectively. At the right plane, high temperature takes place below the ventilating lids at the rear part of the smoking room. This may result from high velocity of hot gas flowing out through this ventilating lid. At the middle plane, high temperature takes place in the center part of the model room. This indicates the influence of high velocity of hot gas inlet at the center part of the smoking room.

Results from investigation of temperature at 54 positions on the right and middle planes show that temperatures at the right plane are between 66–72°C. Temperatures at the middle plane are between 68–75°C. Details of temperature at 54 positions of the right and middle planes are given in Appendix B6.

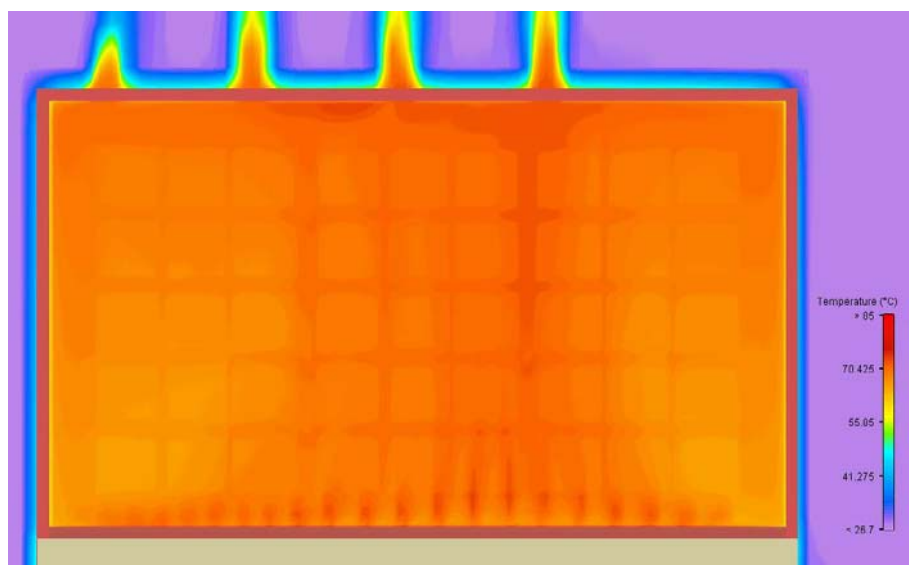


Figure 6.27 Temperature contour on the right plane of the case 5.

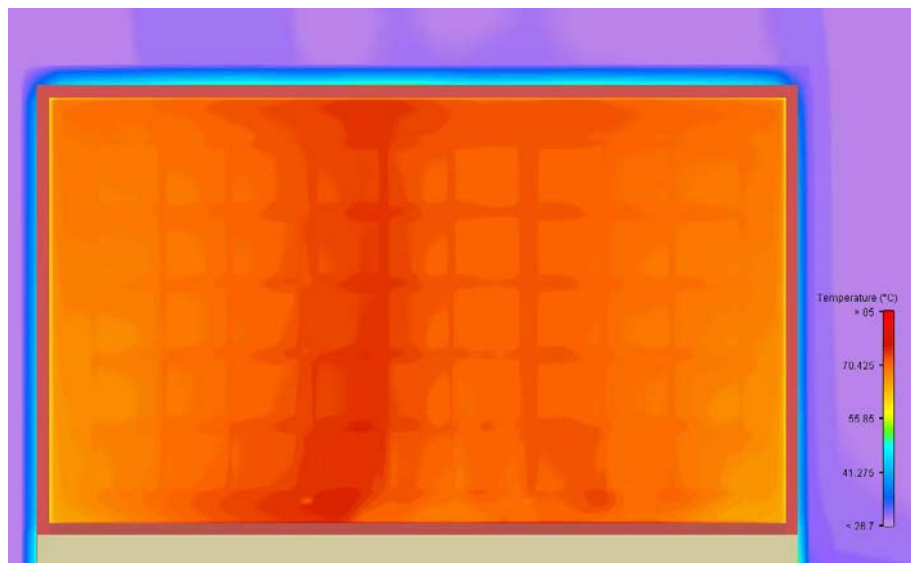


Figure 6.28 Temperature contour on the middle plane of the case 5.

The results show that the ventilating lids have a suitable number because no back-flow of outside air into the room takes place. However, velocity distribution at the right plane is rather non-uniform. Moreover, temperature variation of the middle plane is still much too large. Therefore, to solve these problems, the distance between the ventilating lids will be increased. Some gas supply ducts of the middle rows at the center of the model room will be removed to prevent the high temperature occurrence. The maximum temperature variation has been reduced drastically to 8–9°C.

6.4 Effects of position, number, and size of gas supply ducts and ventilating lids

Results of the preceding model room show that temperature variation in the smoking room was less than 9°C and velocity distribution was not sufficiently uniform. To obtain better temperature variation, and uniformity of velocity distribution, fine-tuning the position and number of the gas supply ducts and size and position of the ventilation lids is need.

There are two models in this study. In the first model, the distances between gas supply duct rows, and the distances between the ventilating lid columns are unevenly distributed. In the second model, the number of gas supply ducts and size of ventilation lids are reduced. A better model rubber smoking room will then be introduced to continue for the next study.

Case 6

1. Structure details

In this study, 8 ventilating lids with the size of 25 cm × 25 cm were used. Distances between the columns of ventilating lids are, from the front part, 1.2, 1.4 and 1.6 m, respectively. One hundred and sixty eight gas supply ducts were used. The distances between the rows of the gas supply ducts were not evenly distributed as in the preceding model room. Positions of the gas supply ducts and the ventilating lids are shown in Fig. 6.29. Detail of the positions of the gas supply ducts is given in Appendix C1.

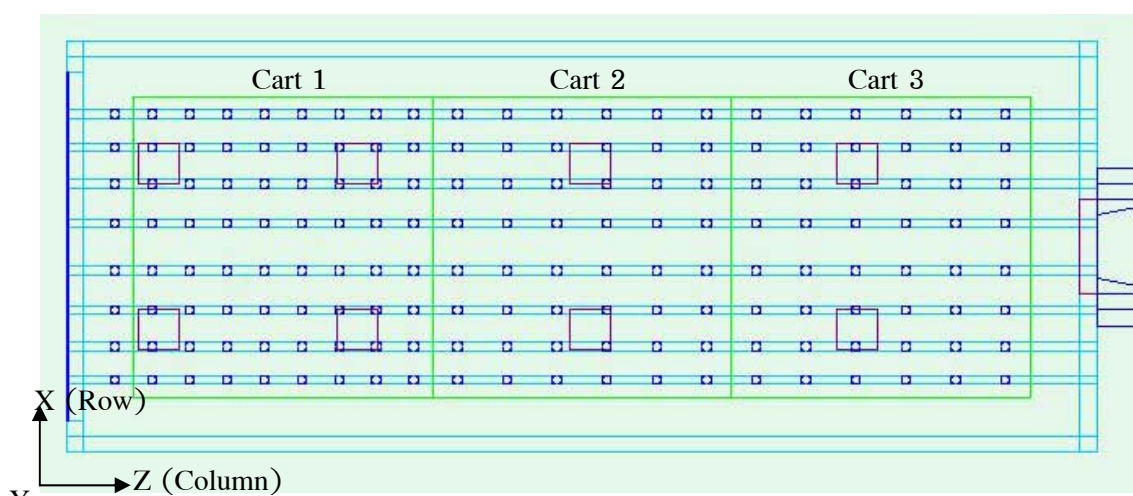


Figure 6.29 Positions of the ventilating lids and the gas supply ducts of the case 6 shown from top view.

2. Results and discussion

Flow pattern

Flow patterns of hot gas on the right and middle planes are shown in Fig. 6.30 and Fig. 6.31, respectively. At the right plane, the high velocity region takes place at the center part of the model room. This may be the result of the flow of high velocity gas into the center part of the smoking room. Moreover, low velocity at the right plane occurs near the front and rear parts of the smoking room.

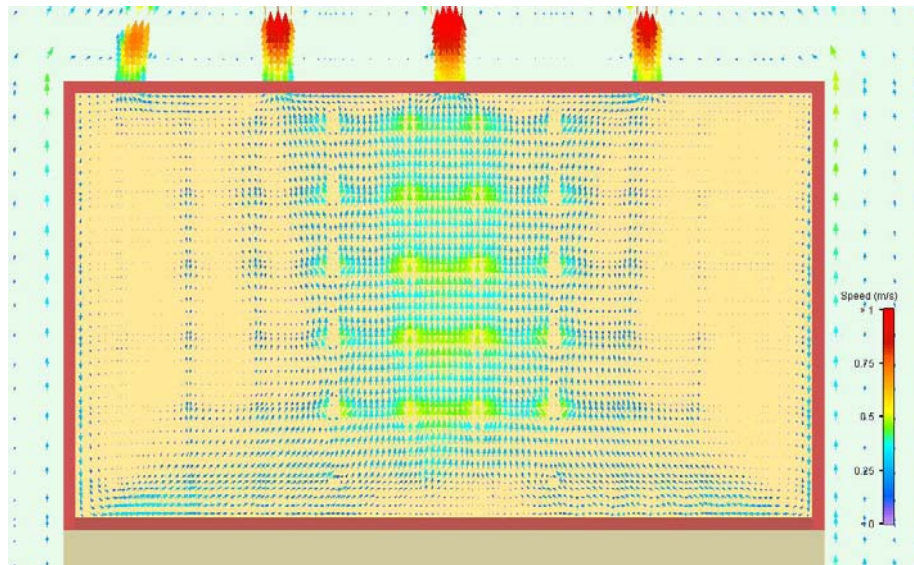


Figure 6.30 Flow pattern on the right plane of the case 6.

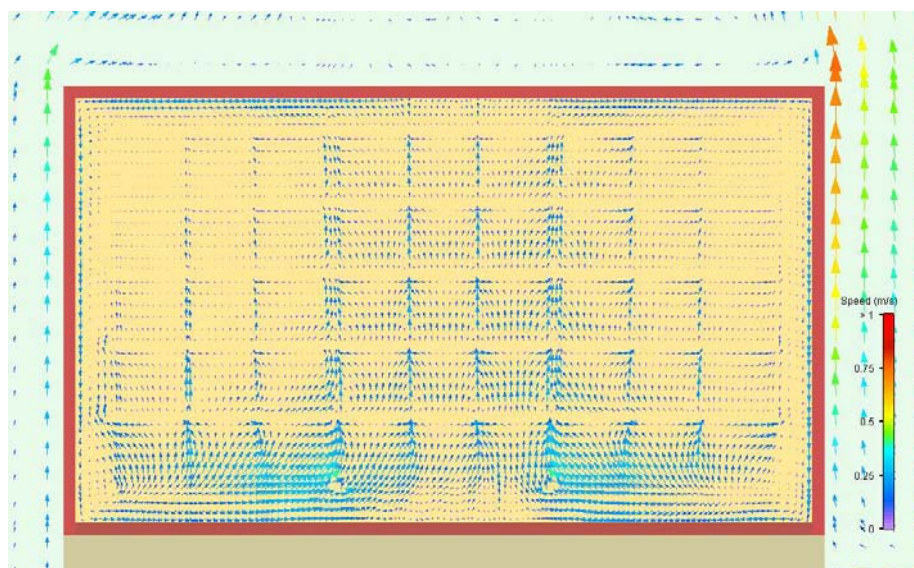


Figure 6.31 Flow pattern on the middle plane of the case 6.

Temperature

Temperature contours of the right and middle planes are shown in Figs. 6.32 and 6.33, respectively. At the right and middle planes, high temperature takes place below the ventilating lids at the center part of the smoking room. This indicates the influence of the high velocity of hot gas inlet at the center part of the smoking room.

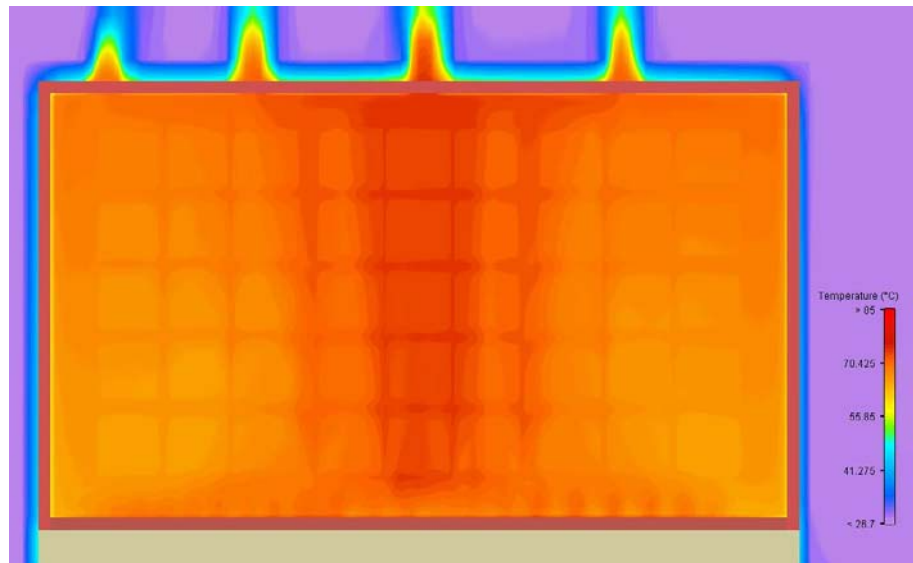


Figure 6.32 Temperature contour on the right plane of the case 6.

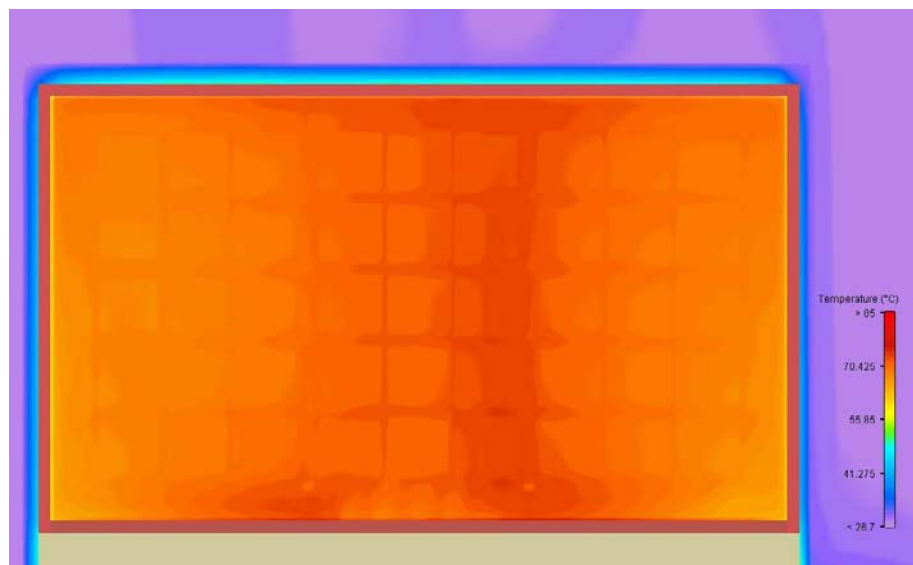


Figure 6.33 Temperature contour on the middle plane of the case 6.

Results from investigation of temperature at 54 positions of the right and middle planes show that temperatures at the right plane are between 66–73°C, while temperatures at the middle plane are between 68–73°C. Details of temperature at 54 positions of the right and middle planes are given in Appendix B7.

In this case the maximum temperatures at the right and middle planes are identical. It means that temperatures are well distributed across the width of the room. Also, temperature variation in this room is less than 7°C which is lower than the value in the

preceding model room. However, temperature and velocity distributions at the right plane show that high flow of hot gas occurs at the middle part of the room. In the next study, this problem will be solved by reducing the number of the gas supply ducts and the size of the ventilating lids at the center part of the model room.

Case 7

1. Structure details

In this study, 4 ventilating lids with the size of $25\text{ cm} \times 25\text{ cm}$ and 4 ventilating lids with the size of $25\text{ cm} \times 20\text{ cm}$ were used. Distances between the columns of ventilating lids are, from the front part, 1.2, 1.4 and 1.6 m, respectively. One hundred and fifty four gas supply ducts were used. Some gas supply ducts were removed from the preceding model room. The distances between the rows of the gas supply ducts were not evenly distributed. Positions of the ventilating lids and the gas supply ducts are shown in Fig. 6.34. Detail of the positions of gas supply ducts and the ventilating lids is given in Appendix C.

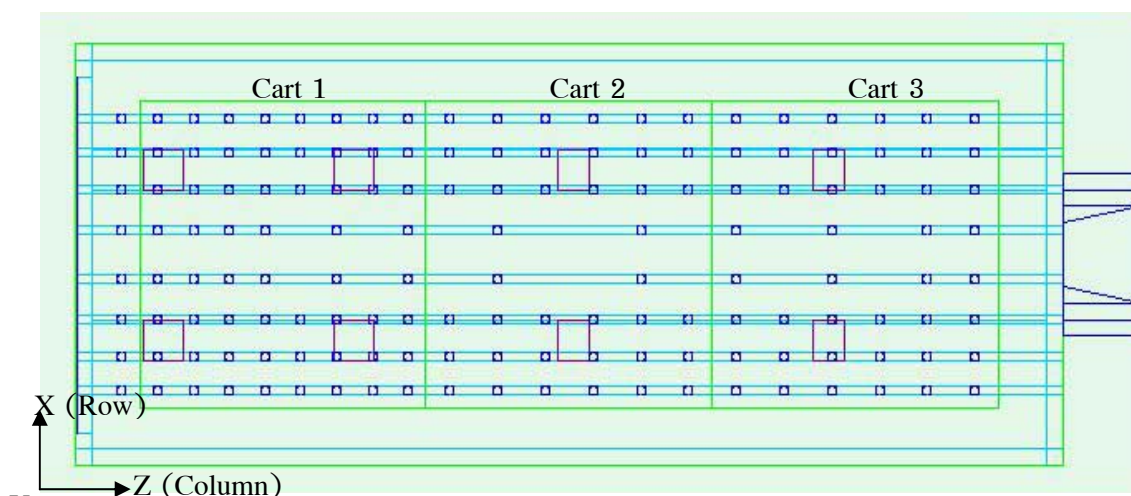


Figure 6.34 Positions of the ventilating lids and the gas supply ducts of the case 7 shown from top view.

2. Results and discussion

Flow pattern

Flow patterns of hot gas at the right and middle planes are shown in Figs. 6.35 and 6.36, respectively. At the right plane, velocity distribution is significantly improved from

the previous model rooms. Anyway, low velocity occurs near the front and rear ends of the room. However, most of these areas are empty space outside the rubber hanging carts; therefore this is not comprehensively studied in this research.

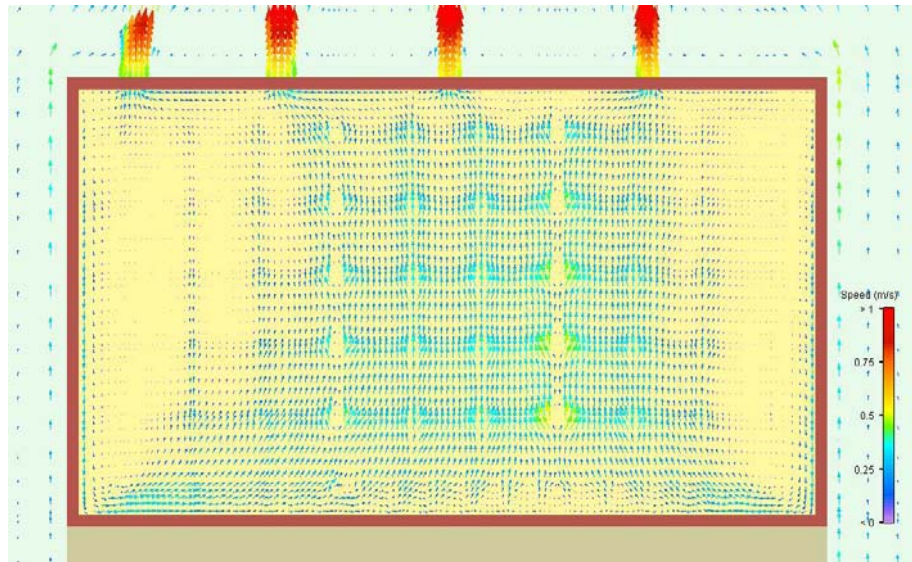


Figure 6.35 Flow pattern on the right plane of the case 7.

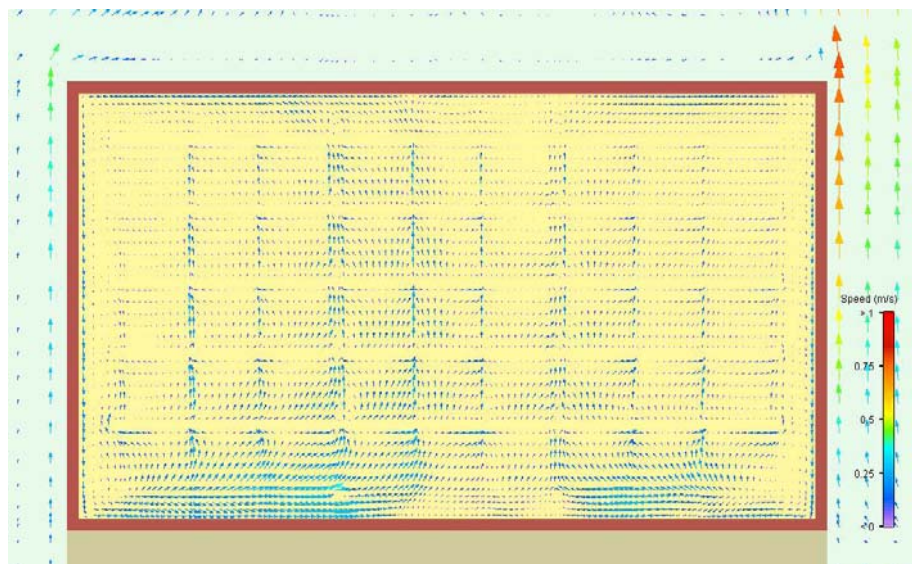


Figure 6.36 Flow pattern on the middle plane of the case 7.

Temperature

Temperature contours at the right and middle planes of the model room are shown in Figs. 6.37 and 6.38, respectively.

Results from investigation of temperature at 54 positions of the right and middle planes show that temperatures at the right plane are between 67–72°C, while temperatures at the middle plane are 68–73°C. Details of temperature at 54 positions of the right and middle planes are given in Appendix B8.

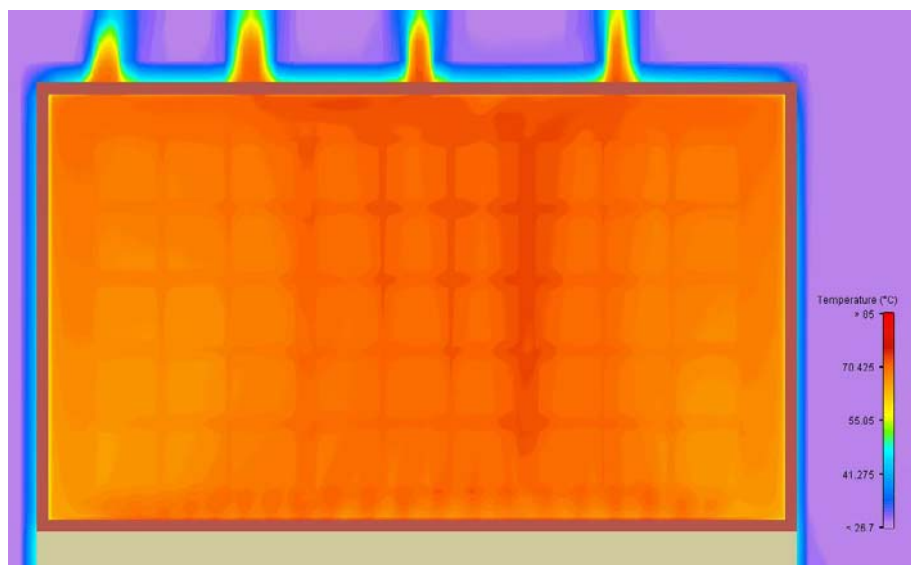


Figure 6.37 Temperature contour on the right plane of the case 7.

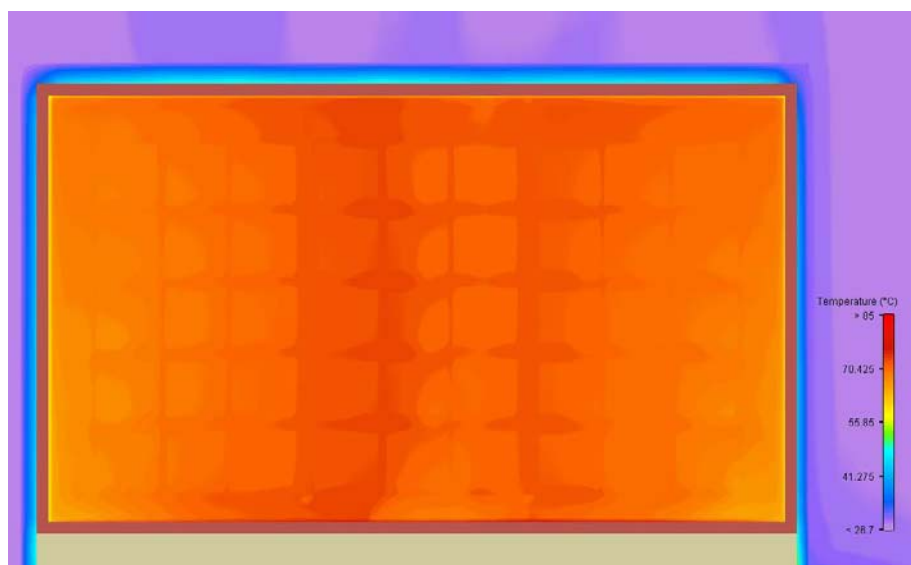


Figure 6.38 Temperature contour on the middle plane of the case 7.

In conclusion, this model room (case study 7) gives good results of temperature and velocity distributions. Maximum temperature variation in the model room is found to be only 5°C, while the velocity distribution is sufficiently uniform.

However, average temperature in this model room is about 70°C which is higher than the suitable temperature used for rubber sheet smoking process. It should not exceed 60°C, in general. This high temperature is a result of the removal of exhaust draining (draft) tube. All of the hot gas then flows into the smoking room. The heat source of this model is still the same as the original present smoking room (16,000 W). Therefore, in the next case study, the heat source input will be reduced so that the average temperature of the smoking room does not exceed the suitable temperature (60°C). This means that the efficiency of fuel usage will be increased.

6.5 Adjustment of the heat source input to the new model room

The acceptance of a new model of the rubber smoking room depends on temperature and velocity distributions for suitable rubber smoking process. In general smoking process, maximum temperature should be controlled at about 60°C. However, in the preceding case study, the average temperature of the model room was about 70°C. In this study, the heat source input will be iteratively reduced so that the average temperature is about 60°C.

Case 8

In this simulation, the geometry of the smoking room remained unchanged from the case study 7. However, the heat source was reduced from 16,000 W to 8,000 W or a 50% reduction.

Results and discussion

Flow pattern

Flow patterns of hot gas at the right and middle planes of the model room are shown in Figs. 6.39 and 6.40, respectively. Characteristic of velocity distribution in this case is the same as the case study 7.

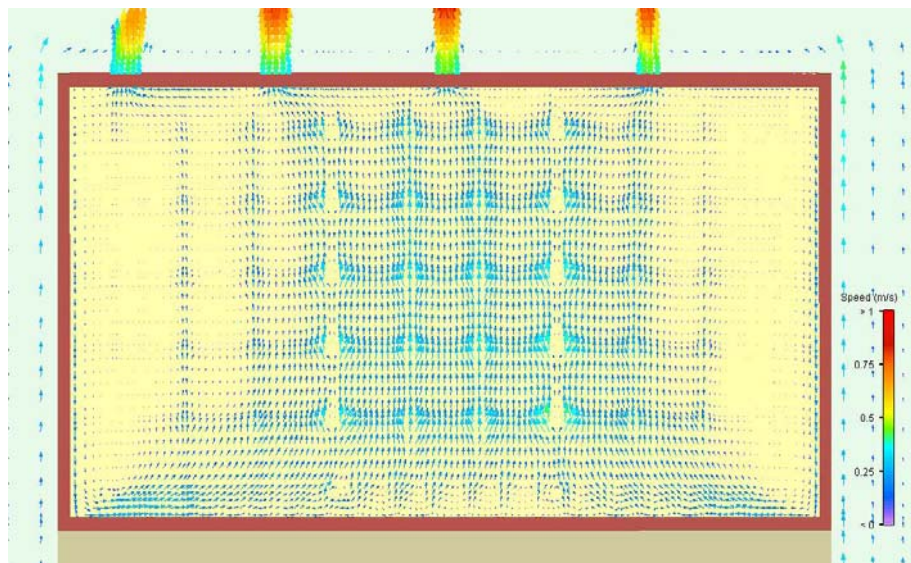


Figure 6.39 Flow pattern on the right plane of the case 8.

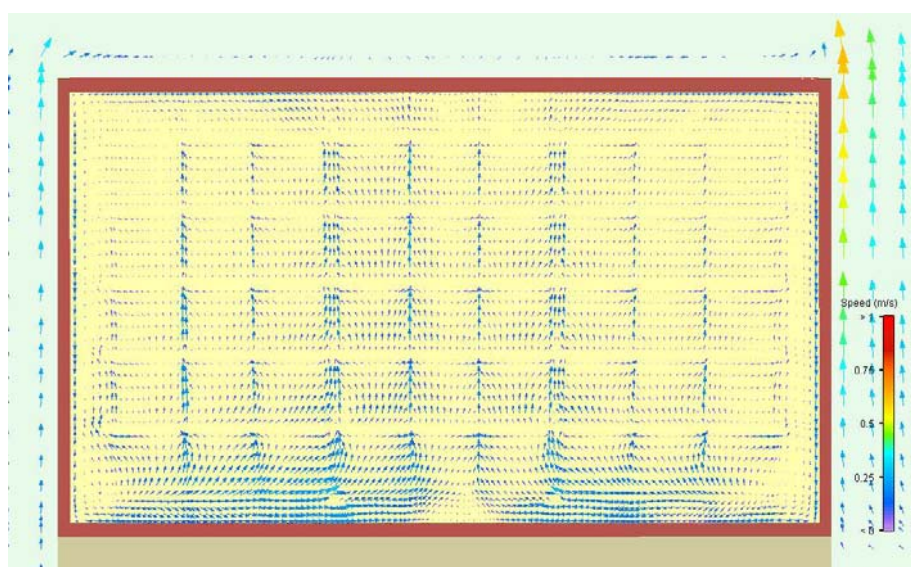


Figure 6.40 Flow pattern on the middle plane of the case 8.

Temperature

Temperature contours at the right and middle planes of the model room are shown in Figs. 6.41 and 6.42, respectively. Both figures show that temperature difference is small.

Results from investigation of temperature at 54 positions of the right and middle planes show that temperatures at the right plane are between 51.0–54.3°C. Temperatures at the middle plane are 52.0–55.2°C. Details of temperature at 54 positions of the right and middle planes are given in Appendix B9.

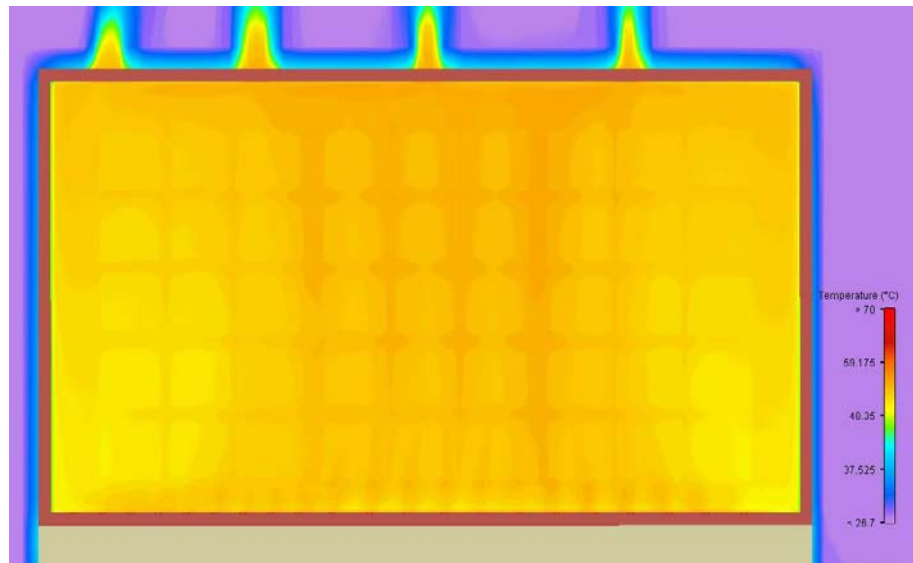


Figure 6.41 Temperature contour on the right plane of the case 8.

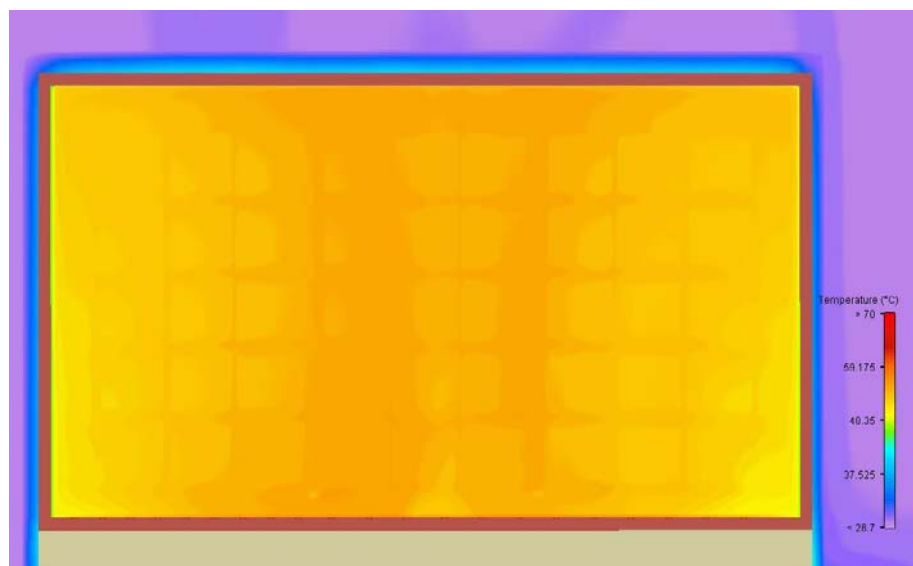


Figure 6.42 Temperature contour on the middle plane of the case 8.

Temperature variation of this model room is about 4.2°C which is lower than the case study 7. Position of maximum temperature is the same as in the case study 7 (i.e. near the center of the middle plane). However, the position of the minimum temperature moves from the front part to the rear part of the right plane.

This model gives good results of temperature and velocity distributions. Average velocity of this model is about 0.25 m/s . Average temperature of the model is about 53.2°C , which is lower than the suitable temperature for rubber smoking process (60°C),

therefore, the heat source input will be increased. The suitable temperature, for the next study can be approximated by the relationship between the heat source input and average temperature of the previous case. Then the fine-tuning is necessary.

Case 9

Heat source input in this study simulation was adjusted to 12,000 W. Everything else remained unchanged from case 8.

Results and discussion

Flow pattern

Flow patterns of hot gas at the right and middle planes of the model room are shown in Fig. 6.43 and Fig. 6.44, respectively. Characteristic of velocity distribution in this case is the same as case study 7 and 8.

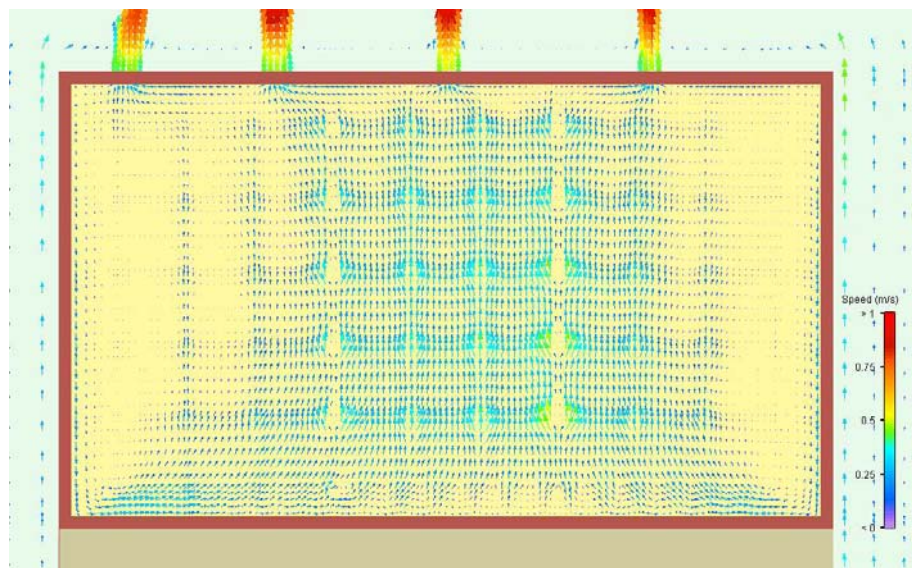


Figure 6.43 Flow pattern on the right plane of the case 9.

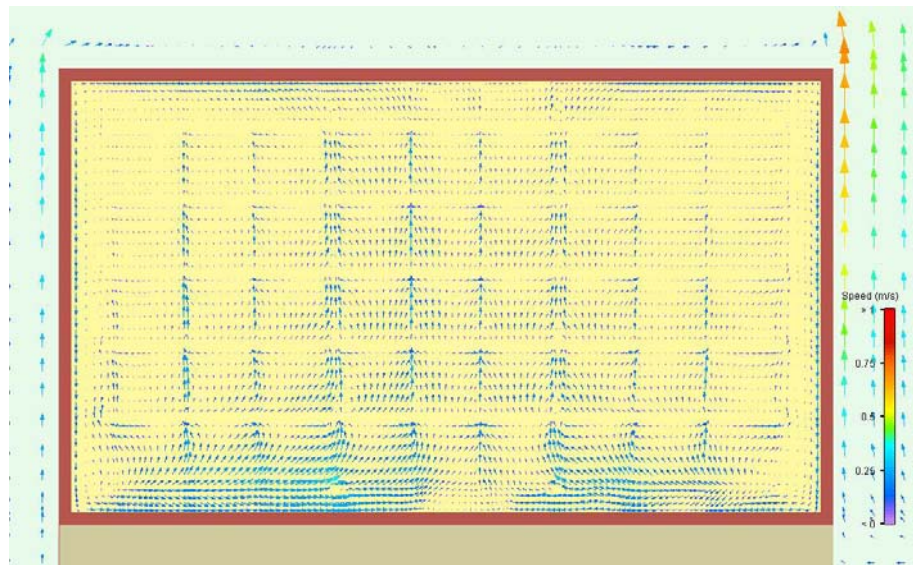


Figure 6.44 Flow pattern on the middle plane of the case 9.

Temperature

Temperature contours at the right and middle planes of the model room are shown in Figs. 6.45 and 6.46, respectively. Both figures show a small temperature difference.

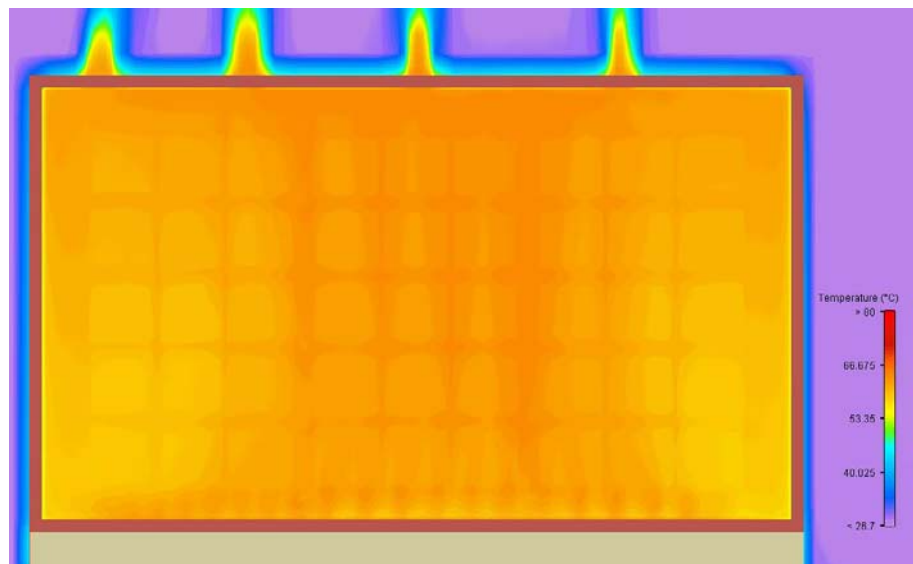


Figure 6.45 Temperature contour on the right plane of the case 9.

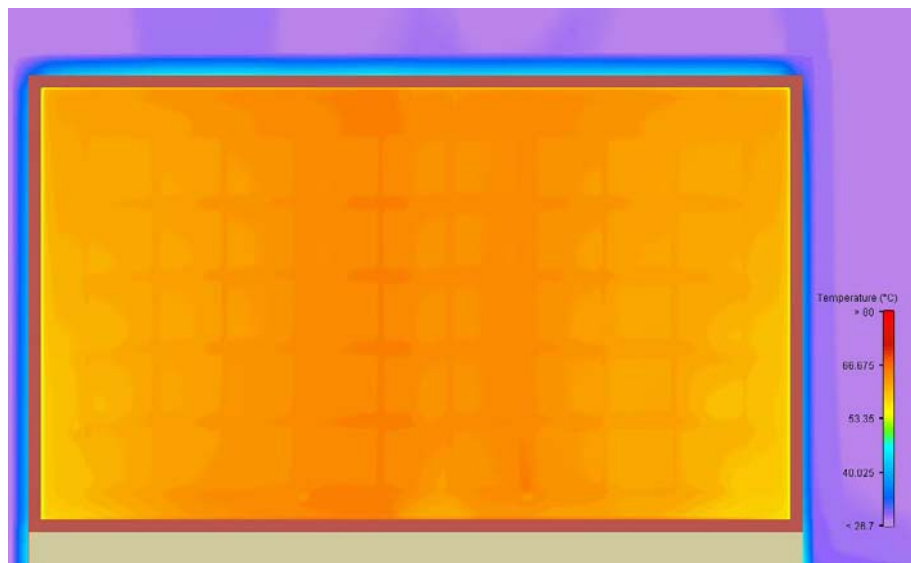


Figure 6.46 Temperature contour on the middle plane of the case 9.

Results from investigation of temperature at 54 positions on the right and middle planes show that temperatures at the right plane are between 59.0–63.5°C, while temperatures at the middle plane are between 61.0–64.5°C. Details of temperature at 54 positions of the right and middle planes are given in Appendix B9. Moreover, the positions of maximum and minimum temperature are the same as in case 8.

This model gives good results of temperature and velocity distributions. Average velocity of this model is about 0.25 m/s. The temperature variation of this model room is about 5.5°C. Average temperature of the model is about 62.1°C, which is slightly higher than the suitable level (60°C). Further adjustment of the heat source within the command center of the program shows that the optimal level of the heat source is about 11,000 W. In this case the temperature variation is 5.3°C and the average temperature is 60.4°C.

6.6 Conclusions

Results from simulation to improve the rubber smoking room indicate that size, position and number of gas supply ducts and ventilating lids significantly affect the temperature and velocity distributions. The optimal rubber sheet smoking room with the size of 2.6 m × 6.2 m × 3.6 m contains 154 hot gas supply ducts, and four 25 cm × 25 cm ventilating lids and four 25 cm × 20 cm ventilating lids as shown in case study 7–9. The suitable heat source input is 11,000 W. This is equivalent to feeding of 15.3 kg of firewood (60.5% per dry basis) in 2 hrs. The reason for choosing this size of the smoking

room is that it is suitable for general rubber smoking cooperatives located throughout the country. It should be kept in mind that the simulation here assumes the steady-flow condition which is usually not the case in the actual smoking process. However, this improved model should help the rubber smoking cooperatives to save energy about 27% as the heat source input can be reduced by that percentage from the original rubber smoking room.