

As the name implies, indoor air pollution deals with air contamination in enclosed spaces such as homes, offices, work areas, etc. Suppose that you are designing a ventilation system for a restaurant as shown in Fig. 1 below. The restaurant serving area consists of two square rooms and one elongated room. Room 1 and room 3 have sources of carbon monoxide from smokers and a faulty grill, respectively. Steady-state mass balances can be written for each room. For example, for the smoking section (room 1), the balance can be written as

$$0 = \begin{matrix} W_{\text{smoker}} \\ \text{(load)} \end{matrix} + \begin{matrix} Q_a c_a \\ \text{(inflow)} \end{matrix} - \begin{matrix} Q_a c_1 \\ \text{(outflow)} \end{matrix} + \begin{matrix} E_{13}(c_3 - c_1) \\ \text{(exchange)} \end{matrix}$$

or substituting the parameters:

$$225c_1 - 25c_3 = 3400$$

Similar balances can be written for the other rooms.

- Solve for the steady-state concentration of carbon monoxide in each room.
- Determine what percent of the carbon monoxide in the kids' section is due to (i) the smokers, (ii) the grill, and (iii) the air in the intake vents.
- If the smoker and grill loads are increased to 4000 and 6000 mg/hr, respectively, use the matrix inverse to determine the increase in the concentration in the kids' section.
- How does the concentration in the kids' section change if a screen is constructed so that the mixing between areas 2 and 4 is decreased to 5 m<sup>3</sup>/hr?

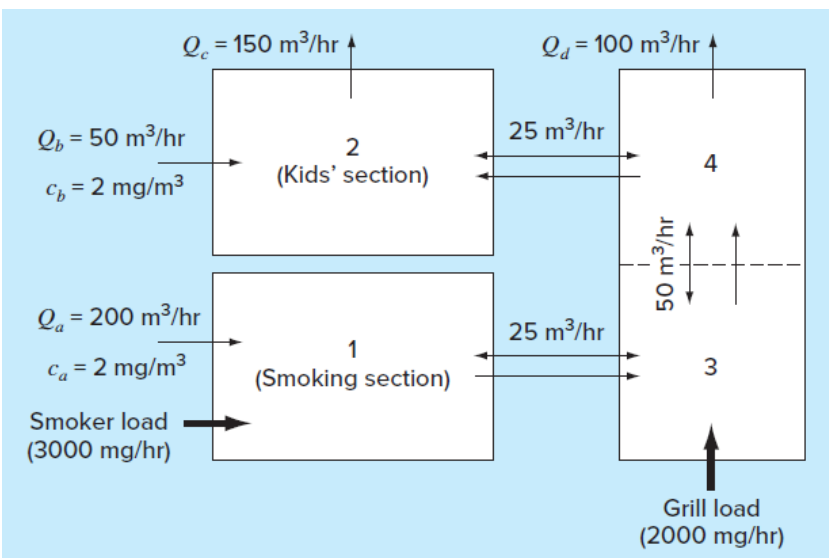


Figure 1. Overhead view of rooms in a restaurant. The one-way arrows represent volumetric airflows, whereas the two-way arrows represent diffusive mixing or exchange. The smoker and grill loads add carbon monoxide mass to the system but negligible airflow.

## **Deliverables**

Your report should include the description of the problem, how you set up the problem, assumptions, method of solution, the Matlab/Octave code that you used, the results, all relevant plots, discussion and potential weaknesses in your solution method. Upload your work to the elearning website in a zip file containing all relevant files.