STATIC DRAFT IN CHIMNEY

1.   TECHNICAL DESCRIPTION, BACKGROUND

In a restaurant, the fireplace in the dining hall spews out smoke when the exhaust fan in the kitchen range hood is used. The restaurant does not know why this happens, and ask for help.

2.   PHENOMENON

- The smoke goes into the dining hall, instead of out the chimney.

3.   FIND THE REASON

- Why does the smoke not go up the chimney?

4.   ENGINEERING CALCULATIONS

A/   Calculate the static draft in the chimney, in order to find the amount of pressure difference that the chimney causes (The pressure difference between points 0 and 2, when the chimney is closed off, while filled with fume gas.). Then compare this to the pressure difference caused by the exhaust fan.

B/   How would you eliminate the problem?

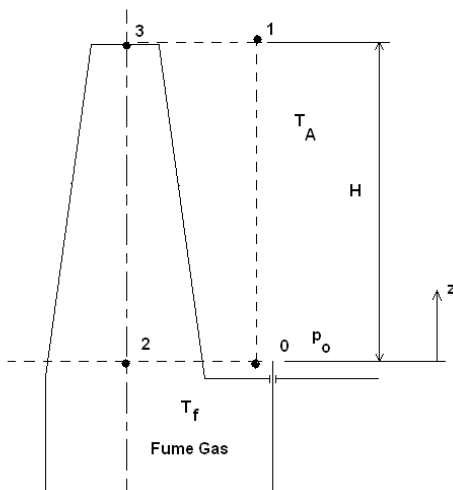C/   Draw a graph of the pressure as a function of the height.

Figure 1.

Data:

Height of the chimney $H = 1$ [m]

Gravity $g = 9.81$ [N/kg]

Fume temperature $Tf = 600$ [K]

Air temperature $TA = 293$ [K]

Gas constant of air $RA = 287$ [$J/(kg\ K)$]