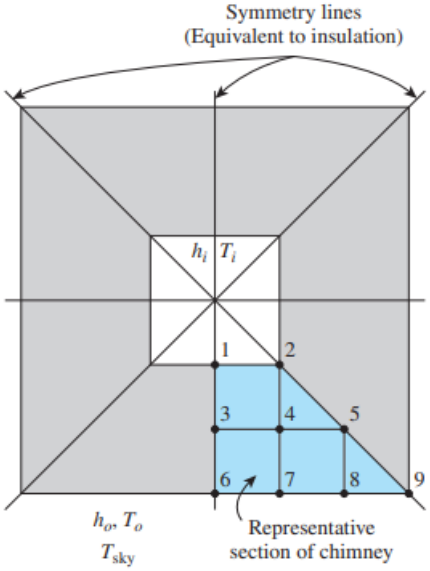
Assignment 03

Hot combustion gases of a furnace are flowing through a square chimney made of concrete (k= 1.4 W/m·K). The flow section of the chimney is 20 cm x 20 cm, and the thickness of the wall is 20 cm. The average temperature of the hot gases in the chimney is Ti = 300°C, and the average convection heat transfer coefficient inside the chimney is hi = 70 W/m2·K. The chimney is losing heat from its outer surface to the ambient air at To = 20°C by convection with a heat transfer coefficient of ho = 21 W/m2·K and to the sky by radiation. The emissivity of the outer surface of the wall is e = 0.9, and the effective sky temperature is estimated to be 260 K. Using the finite difference method with Dx = Dy = 10 cm and taking full advantage of symmetry, determine the temperatures at the nodal points of a cross section and the rate of heat loss for a 1-m-long section of the chimney.



Write a generalized code where user can set Dx, Dy of their choice.(Smaller Dx, Dy will increase the no of nodes).

You need to submit your code along with a pdf where

1. The equations you have solved for each node are explicitly written for Dx=Dy=10cm.
2. The average temperature of the outer and inner wall are mentioned explicitly for both grid sizes.
3. Rate of heat transfer for 1m length of the chimney is explicitly stated for the two grid sizes.