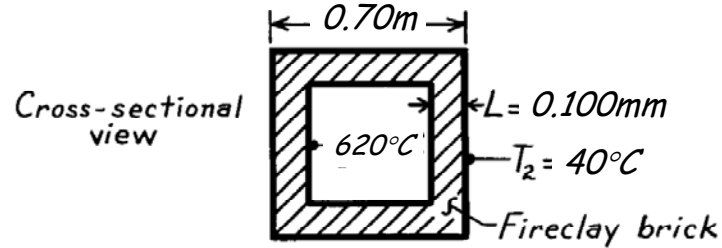# PROBLEM 4.20

KNOWN: Cubical furnace, 700 mm external dimensions, with 100 mm thick walls.

FIND: The heat loss, q(W).

SCHEMATIC:

ASSUMPTIONS: (1) Steady-state conditions, (2) Two-dimensional conduction, (3) Constant properties.

PROPERTIES: *Table A-3*, Fireclay brick $\left(\overline{T} = (T_1 + T_2)/2 = 603K\right)$: $k \approx 1.1$ W/m·K.

ANALYSIS: Using relations for the shape factor from Table 4.1,

Plane Walls (6)	$S_W = \dfrac{A}{L} = \dfrac{0.50 \times 0.50 m^2}{0.10 m} = 2.5m$
Edges (12)	$S_E = 0.54D = 0.54 \times 0.50m = 0.27m$
Corners (8)	$S_C = 0.15L = 0.15 \times 0.10m = 0.015m.$

The heat rate in terms of the shape factors is

$$q = kS(T_1 - T_2) = k(6S_W + 12S_E + 8S_C)(T_1 - T_2)$$
$$q = 1.1\frac{W}{m \cdot K}(6 \times 2.5m + 12 \times 0.27m + 8 \times 0.015m)(620 - 40)^\circ C$$

$$q = 11.7 \text{ kW}.$$ <

COMMENTS: Note that the restrictions for S_E and S_C have been met.