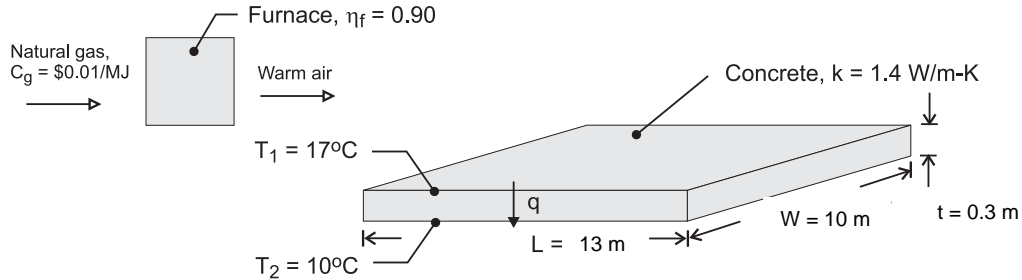


PROBLEM 1.4

KNOWN: Dimensions, thermal conductivity and surface temperatures of a concrete slab. Efficiency of gas furnace and cost of natural gas.

FIND: Daily cost of heat loss.

SCHEMATIC:



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

ANALYSIS: The rate of heat loss by conduction through the slab is

$$q = k (LW) \frac{T_1 - T_2}{t} = 1.4 \text{ W/m} \cdot \text{K} (13 \text{ m} \times 10 \text{ m}) \frac{7^\circ\text{C}}{0.30 \text{ m}} = 4247 \text{ W} \quad <$$

The daily cost of natural gas that must be combusted to compensate for the heat loss is

$$C_d = \frac{q C_g}{\eta_f} (\Delta t) = \frac{4247 \text{ W} \times \$0.02 / \text{MJ}}{0.9 \times 10^6 \text{ J / MJ}} (24 \text{ h/d} \times 3600 \text{ s/h}) = \$8.15 / \text{d} \quad <$$

COMMENTS: The loss could be reduced by installing a floor covering with a layer of insulation between it and the concrete.