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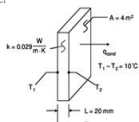
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PROBLEM 1.1

KNOWN: Thermal conductivity, thickness and temperature difference across a sheet of rigid extruded insulation.

FIND: (a) The heat flux through a 2 m x 2 m sheet of the insulation, and (b) The heat rate through the sheet.

SCHEMATIC:



ASSUMPTIONS: (1) One-dimensional conduction in the x-direction, (2) Steady-state conditions, (3) Constant properties.

ANALYSIS: From Equation 1.2 the heat flux is

$$q''_x = -k \frac{dT}{dx} = k \frac{T_1 - T_2}{L}$$

Solving,

$$q''_x = 0.029 \frac{\text{W}}{\text{m} \cdot \text{K}} \frac{10 \text{ K}}{0.02 \text{ m}}$$

$$q''_x = 14.5 \frac{\text{W}}{\text{m}^2} \quad <$$

The heat rate is

$$q_x = q''_x A = 14.5 \frac{\text{W}}{\text{m}^2} \times 4 \text{ m}^2 = 58 \text{ W} \quad <$$

COMMENTS: (1) Be sure to keep in mind the important distinction between the heat flux (W/m^2) and the heat rate (W). (2) The direction of heat flow is from hot to cold. (3) Note that a temperature difference may be expressed in kelvins or degrees Celsius.

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