PROBLEM 1.8

KNOWN: Dimensions and thermal conductivity of food/beverage container. Inner and outer surface temperatures.

FIND: Heat flux through container wall and total heat load.

SCHEMATIC:



ASSUMPTIONS: (1) Steady-state conditions, (2) Negligible heat transfer through bottom wall, (3) Uniform surface temperatures and one-dimensional conduction through remaining walls.

ANALYSIS: From Fourier's law, Eq. 1.2, the heat flux is

$$q'' = k \frac{T_2 - T_1}{L} = \frac{0.023 \text{ W/m} \cdot \text{K} (20 - 2)^\circ \text{C}}{0.025 \text{ m}} = 16.6 \text{ W/m}^2$$
 <

Since the flux is uniform over each of the five walls through which heat is transferred, the heat load is

$$q = q'' \times A_{total} = q'' [H(2W_1 + 2W_2) + W_1 \times W_2]$$

$$q = 16.6 \text{ W/m}^2 [0.6m(1.6m + 1.2m) + (0.8m \times 0.6m)] = 35.9 \text{ W} <$$

COMMENTS: The corners and edges of the container create local departures from onedimensional conduction, which increase the heat load. However, for H, W_1 , $W_2 >> L$, the effect is negligible.

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