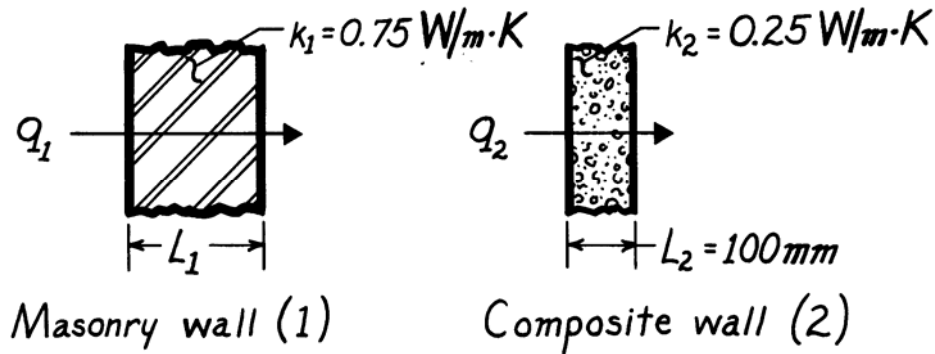


PROBLEM 1.13

KNOWN: Masonry wall of known thermal conductivity has a heat rate which is 80% of that through a composite wall of prescribed thermal conductivity and thickness.

FIND: Thickness of masonry wall.

SCHEMATIC:



ASSUMPTIONS: (1) Both walls subjected to same surface temperatures, (2) One-dimensional conduction, (3) Steady-state conditions, (4) Constant properties.

ANALYSIS: For steady-state conditions, the conduction heat flux through a one-dimensional wall follows from Fourier's law, Eq. 1.2,

$$q'' = k \frac{\Delta T}{L}$$

where ΔT represents the difference in surface temperatures. Since ΔT is the same for both walls, it follows that

$$L_1 = L_2 \frac{k_1}{k_2} \cdot \frac{q_2''}{q_1''}.$$

With the heat fluxes related as

$$q_1'' = 0.8 q_2''$$

$$L_1 = 100 \text{ mm} \frac{0.75 \text{ W/m}\cdot\text{K}}{0.25 \text{ W/m}\cdot\text{K}} \times \frac{1}{0.8} = 375 \text{ mm.} \quad <$$

COMMENTS: Not knowing the temperature difference across the walls, we cannot find the value of the heat rate.