Chapter 16   Problem 31 [†]

Given

$l = 12\ m$

$w = 8.0\ m$

$\Delta x = 23\ cm = 0.23\ m$

$T_i = 20\ ^{\circ}C$

$T_g = 10\ ^{\circ}C$

$k_{concrete} = 1 W/m\ K$

Solution

Find the heat flow into the ground.

The formula for heat loss due to conduction is

$$H = -kA\frac{\Delta T}{\Delta x}$$

The area of the floor is just the length times the width. Therefore, our equation becomes

$$H = -klw\frac{(T_g - T_i)}{\Delta x}$$

Substituting in the known values gives us

$$H = -(1\ W/m \cdot K)(12\ m)(8.0\ m)\frac{(10\ ^{\circ}C - 20\ ^{\circ}C)}{(0.23\ m)}$$

$$H = 4170\ W = 4.17\ kW$$

[†]Problem from Essential University Physics, Wolfson