User Manual - Heat Conduction Wall

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1 Introduction

This manual is going to show the use of the heat Conduction Wall script. The aforementioned script was written in Python 3.8 using the Spyder IDE. The theory is based on two key formulas. Newton's law of convection and Fourier's law of conduction. See equations 1 and 2

$$\dot{Q} = -kA\frac{\partial T}{\partial x} = -kA\Delta T \tag{1}$$

$$\dot{Q} = hA\Delta T \tag{2}$$

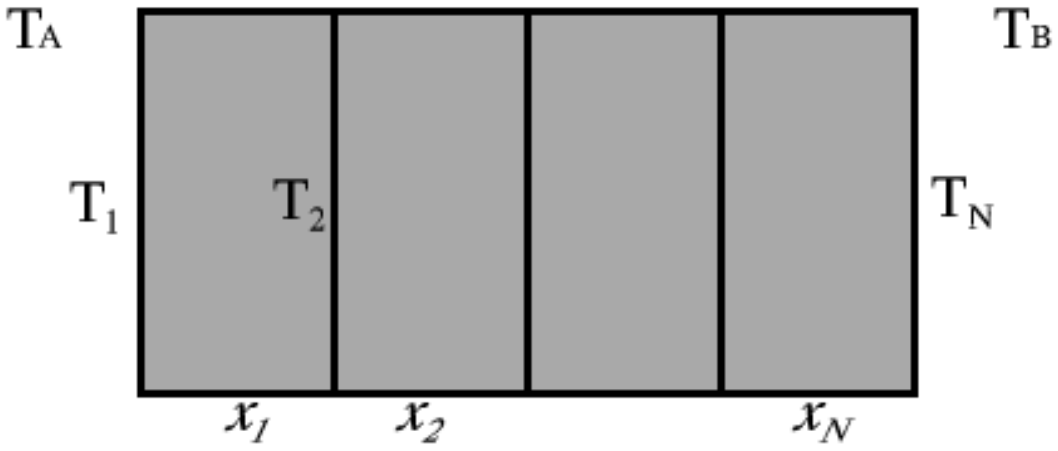

Figure 1: Theoretical Breakdown

For this script T_A is the hottest side therefore according to the zeroth law of thermodynamics, the heat flows from T_A to T_B. The thickness of the wall is denoted by x and k is the thermal conductivity of the wall.

1.1 R Method

Based on the electrical resistance analogy, where the lower the resistance less impedance higher the heat flux and higher the resistance lower the heat flux. High resistance materials have low thermal conductivity, like air.

1.1.1 Assumptions

- The thermal energy making contact on the wall is uniform, meaning there is no hot spots
- T_A is perpendicular to the walls
- The materials are homogeneous
- it is 2D heat transfer
- Radiation is not negligible

$$R_{total} = \frac{1}{Ah_A} + \sum \frac{L_N}{Ak_N} + \frac{1}{Ah_B} \tag{3}$$

$$Q = \frac{\Delta T}{R_{total}} = \frac{T_B - T_A}{R_{total}} \tag{4}$$

Then to find the individual surface temperatures use the 1 and 2 depending on if its wall to wall surface temperature or air to wall surface temperature respectively.

2 How to use

This code is straight forward, run the script and the script will ask for T_A and T_B, h_A and h_b for the system. Then it will ask you for the number of walls in that system, the user can input any integer into the terminal, and finally it will ask the thickness and thermal conductivity for each wall. Then the system will solve the equations and print out the heat flux and the surface temperatures of the system.

If $T_B > T_A$ then the corresponding values will be negative. This is because of zeroth law of thermodynamics.

2.1 Legal

The author assumes no responsibility for any damages that might occur while using the script. Use the script at your own risk.