MAE 431 Heat Transfer Through Semi-Infinite Mediums - Team 5

Team members:

Gilberto Martinez
Bryce Martin
Matthew Mackey
Carlos Magallon

Intro to Semi-Infinite Medium Heat Transfer

- The goal of our project is to find the rate of steady state heat transfer (Q) through different configurations.
- In order to calculate heat transfer a conduction shape factor must be calculated for the desired configuration.
- Conduction shape factors (S) can be calculated using the different configurations in Table 3-7 of the textbook (Heat and Mass Transfer, Fundamentals and Applications 6th ed).

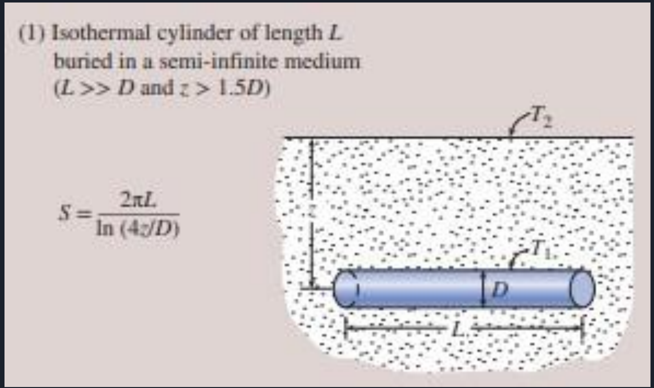
Problem Set Up

An underground pipe for the Long Beach Water District has hot water flowing through it. The pipe is 30 m long with a 0.5 m diameter. It is buried 12 m below the ground with the soil having a thermal conductivity of roughly 0.04 W/(m*K). The surface temperature of the pipe is known to be 350 K while the soil surface temperature is at 293 K. Calculate the steady rate of heat loss from the pipe?

The following equations will be used:

Table 3-7 Equation 1

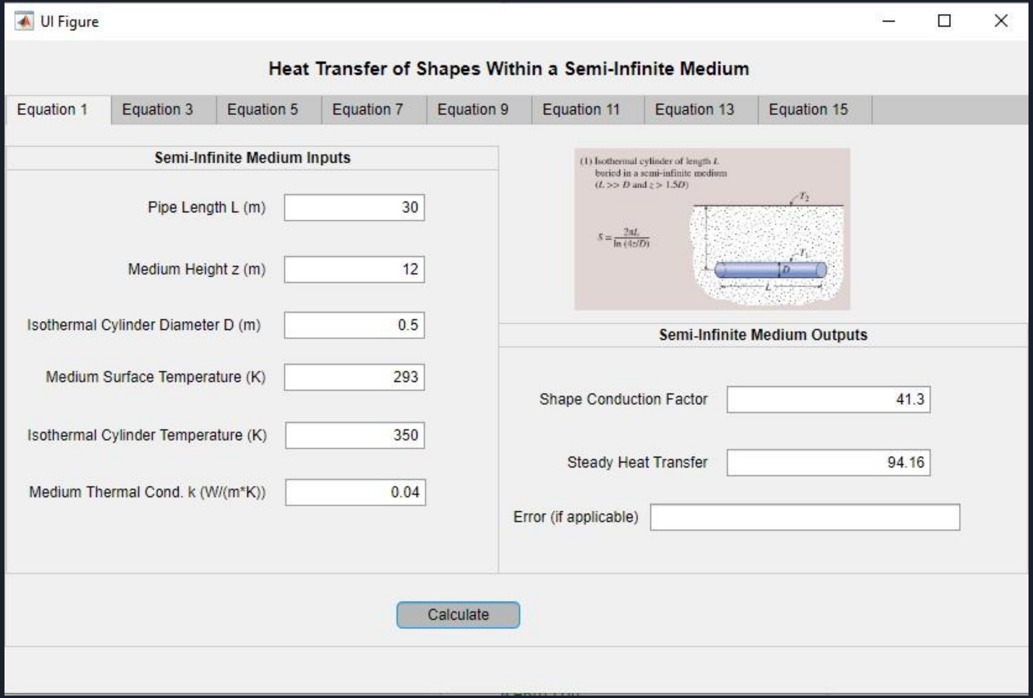
Equation 3-93 - $Q = Sk(T_1-T_2)$



Equation 1 in Table 3-7

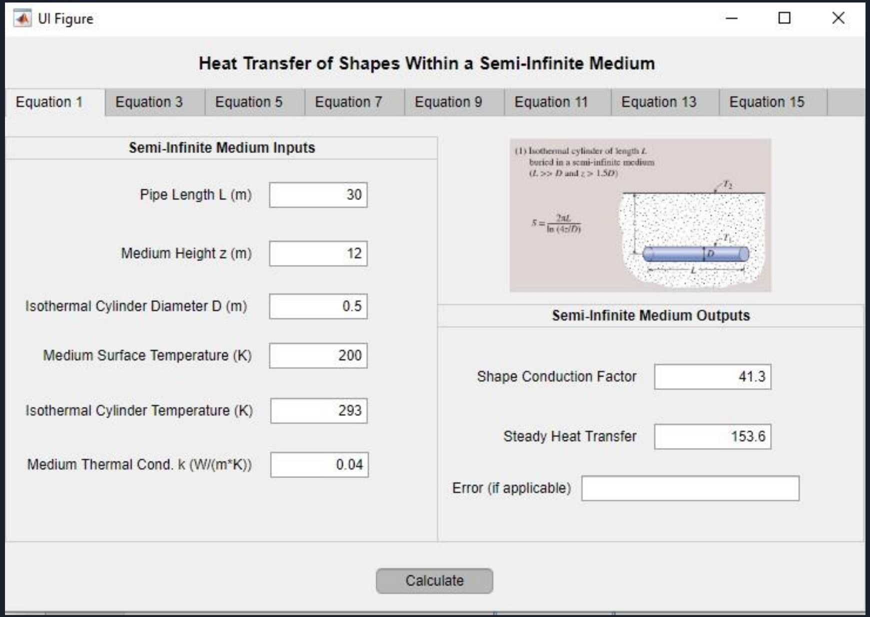
Solution

1. S = 2*π*30/(ln(4*12/0.5)) = 41.3 m
2. Q = 41.297*0.04*(350-293) = 94.16 W



Purpose of the Code:

- Allow users to easily navigate between the different configurations using tabs and pictures for each equation.
- If the user inputs conditions which are not suitable for the equation being used, it will return an error and specify which condition was not met.



Applications

Houses/Commercial Buildings		Suppose a civil engineering firm wanted hot water to transfer from a water heater to a sink through a pipe at temperature T. How hot do they need to water to be inside the heater if the water was flowing a distance x, inside of pipe with diameter D, with an insulation z thick?
Underground Water Pipes		An underground pipe for the Long Beach Water District has hot water flowing through it. Calculate the steady rate of heat loss through the pipe?
Power Plants		To achieve an overall efficiency of 20%, a power plant transfers water to a pump at temperature T1. If water exits a condenser at Temperature T2, how long does the pipe need to be to ensure the condensed water reaches the condenser at T1?

Conclusions

- The user interface is a simpler, quicker, and cheaper way to get rough numbers for these heat transfer configurations.
  - It is much simpler than setting up an FEA or other simulation to gather this data.
  - Solutions can be found within a click of a button instead of hours of set up and calculation time.
  - An overall cheaper way to get rough data as an FEA can be very costly for labor hours and expensive computer processing time.
- For the reasons listed above, we believe that this code would add value to anyone looking to tackle these problems.