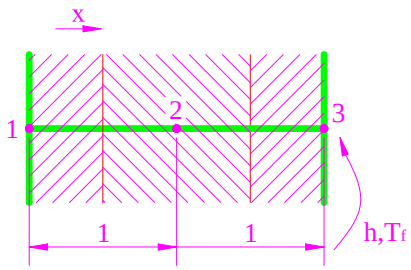
Chapter # 4

Problem # 4-2

Figure as shown below, is one-dimensional steady-state heat conduction problem, where $T_1 = 100$, $\lambda = 5$, $S = 150$, $T_f = 20$, $h = 15$ are known, the unit of every item is in System International (SI) . Try to determine the value of T_2, T_3 by numerical calculation, according to your results, to prove that the entire computational domain meets the requirements of the overall conservation even if only three nodes were took.



Problem # 4-5

In Problem 4-2, set right side of domain for the natural convection, and $h = 10(T_3 - T_f)^{1/4}$, Write down the equation for node 3 , and use local linear method to make the equation linear algebraic , then solve it by iterative method.

Problem # 4-12

Write a program using TDMA algorithm, and use the following method to check its accuracy: set arbitrary values of the coefficients A_i, B_i and $C_i (i = 1,10)$. But B_1 and C_{10} should not be zero. Then setting the reasonable values of temperature $T_1, ..., T_{10}$, calculate the corresponding constants D_i. Apply your program for solving T_i by using the values of A_i, B_i, C_i and D_i, and compare the results with the given value.

Problem # 4-14

According to the problem discussed in section 4.6(The fully developed heat convection in a circular tube), try to analyze the following three dimensionless temperature definitions of $\Theta = \frac{T - T_w}{T_b - T_w}$, $\Theta = \frac{T - T_\infty}{T_w - T_\infty}$ and $\Theta = \frac{T - T_w}{T_\infty - T_w}$, which one is acceptable for separation of variables.

Problem # 4-18

As shown in Figure below, fully developed laminar convective heat transfer in semicircle tube , try to find: 1 , its mathematical expression ; 2 , introducing appropriate dimensionless method , to make the above expression dimensionless ; 3 , derive the formula for fR_e, Nu. The characteristic scale for R_e and Nu is equivalent diameter D_e .