HEAT TRANSFER: COMMENTS [March 10, 2004]

Page

13 7 Lines from bottom: Delete flux, two places.

115 Exercise 2-6 figure: the arrows at each end of the specimen indicate force applied in a load cell.

173 Nonsymmetrical Boundary Conditions

The analysis is incorrect: to do the analysis we let the slab be of thickness L with $0 \le x \le L$, and specify temperatures $T_{s'}$ at $x = 0$ and T_s at $x = L$. Again, we let:

$$T(x,t) = T_1(x) + T_2(x,t)$$

$$\frac{d^2T_1}{dx^2} = 0$$

$$x = 0,\ T_1 = T_{s'}\ ;\ x = L,\ T_1 = T_s$$

$$\text{then } T_1 = T_{s'} + (T_s - T_{s'})\frac{x}{L}$$

$$\frac{\partial T_2}{\partial t} = \alpha \frac{\partial^2 T_2}{\partial x^2}$$

$$x = 0, L : T_2 = 0$$

$$t = 0,\ T_2 = T_0 - T_1$$

Referring to the analysis following Eq. (3.38),

$$T_2(\zeta, \eta) = e^{-\lambda^2\zeta}(A \cos \lambda\eta + B \sin \lambda\eta)$$

$$T_2 = 0 \text{ at } \eta = 0,1$$

$$T_2 = 0 \text{ at } \eta = 0 : 0 = e^{-\lambda^2\zeta}(A + 0),\ A = 0$$

$$T_2 = 0 \text{ at } \eta = 1 : 0 = e^{-\lambda^2\zeta} B \sin \lambda$$

$$\sin \lambda = 0\ ,\ \lambda = n\pi\ ,\ n = 0,1,2,\ldots$$

$$T_2 = \sum_{n=1}^{\infty} B_n e^{-n^2\pi^2\zeta} \sin n\pi\eta$$

$$T_2 = \sum_{n=1}^{\infty} B_n e^{-n^2 \pi^2 Fo} \sin n\pi\eta \frac{x}{L}$$

And the constants B_n must be determined from:

$$\sum_{n=0}^{\infty} B_n \sin n \pi \frac{x}{L} = T_0 - T_{s'} - (T_s - T_{s'}) \frac{x}{L}$$

281 Line 2. For an incompressible liquid we take $c_p = c_v = c$, and neglect $\Delta P/\rho$; see Eq. (1.6b)

426 Line 17: Notice that for constant density and fully developed velocity profile there is no change in kinetic energy along the tube.

433 Line 6: The statement "negligible work done by the viscous stresses" applies only to the derivation of the energy equation: of course the viscous stresses do work to reduce the kinetic energy of the freestream fluid as it enters the boundary layer. Consistent with the negligible work is a negligible change in kinetic energy when using Eq. (1.4) to derive Eq. (5.40).

458 Figure 5-24: The indicated value of u_{max}/U is too high—should be 0.146.

512 Figure 5.44: The indicated thermal boundary layer thickness for Pr = 10 is too small—should be about twice the indicated value.

520 Exercise 5.19: Some texts interpret the ½ ρu_b^2 in the definition of f as kinetic energy; others interpret ρu_b^2 as the dynamic pressure. Actually, both are incorrect. The Darcy friction factor essentially applies to fully developed turbulent flow in a tube. The governing equation is the time-averaged momentum conservation equation (see Exercise 5-48): if this equation is made dimensionless it is seen that ρu_b^2 is properly interpreted as scaling the turbulent shear stress. For laminar flow, the laminar (molecular) shear stress is appropriate.

520 Exercise 5-20: k in the table is the conductivity of the fluid inside the tube when obtaining the temperature profile. However, it is not neglected when obtaining the film thickness, i.e., in Eq. (7.10).

563 The exact value of $F_{13} = 0.447$

568 Of course, G_o is the flux incident on a surface held normal to the sun's rays.

574 Example 6.10: By assuming a well-insulated roof we obtain an upper limit on T_s. Of course, if the roof were perfectly insulated there would be no additional load on the cabin air conditioner.

669 Equation (7-38): the coordinate x is measured from $\varphi = 0$.

830 Comment No. 1: Note also that St/f is independent of Reynolds number so no iteration is required.