CH EN 3453 – Heat Transfer

Introduction to Internal Flow

Sections 8.1 to 8.3

Reminders…

- Homework #7 due Friday
- Help session Wednesday at 4:30pm
  - Room MEB 2325
- Meet in lab on Friday
  - Go directly to the lab (Room MEB 3520)

Internal Flow

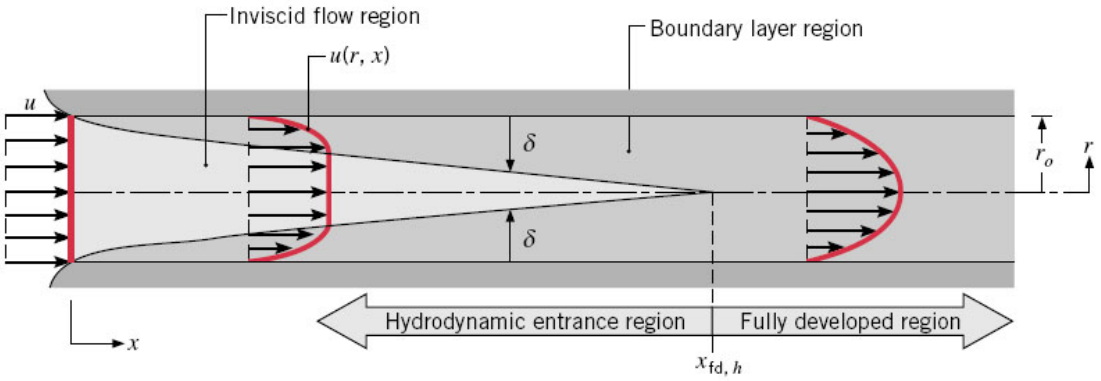


FIGURE 8.1 Laminar, hydrodynamic boundary layer development in a circular tube.

Friction Factors

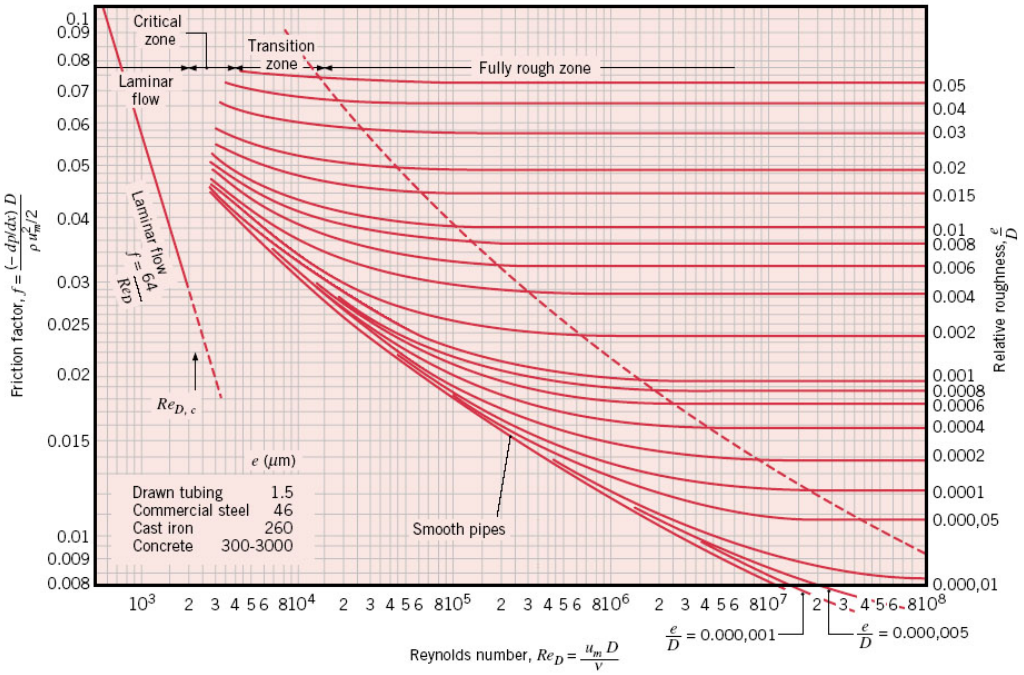


FIGURE 8.3 Friction factor for fully developed flow in a circular tube [3]. Used with permission.

Thermal Boundary Layer

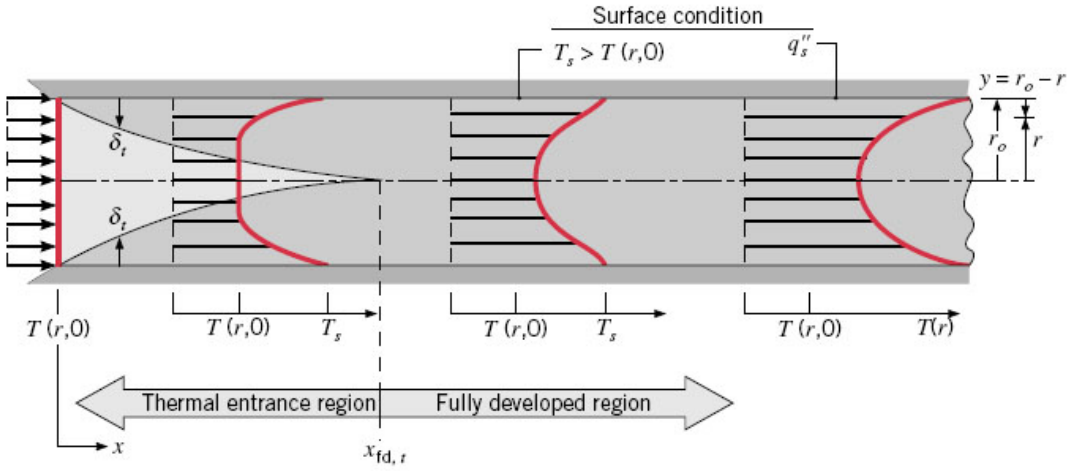


FIGURE 8.4 Thermal boundary layer development in a heated circular tube.

Heat Transfer Coefficient

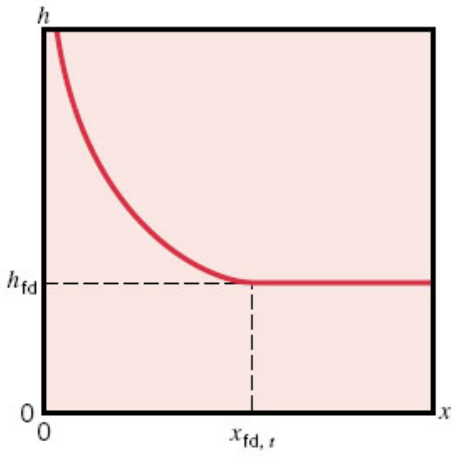
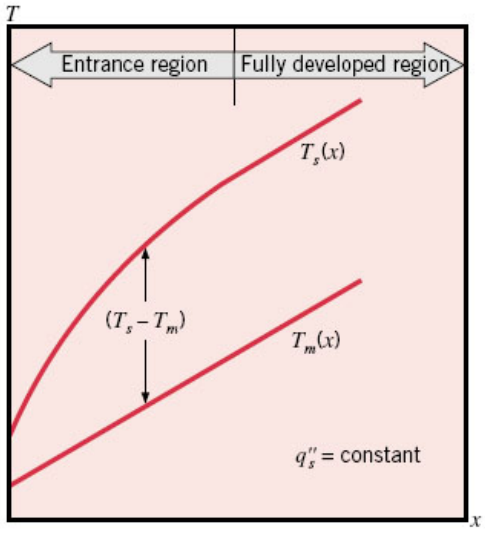


FIGURE 8.5
Axial variation of the convection heat transfer coefficient for flow in a tube.

Axial Temperature Variations



(a)

FIGURE 8.7 Axial temperature variations for heat transfer in a tube. (a) Constant surface heat flux.

Example – Book Problem 8.17

Water at 300K and 5 kg/s enters a black, thin-walled tube, which passes through a furnace whose walls and air are at a temperature of 700K. The diameter and length of the tube are 0.25 and 8 m. Convection coefficients on the inside and outside are 300 and 50 W/m^2·K.

(a) Write an expression for the linearized radiation coefficient. Explain how to calculate this coefficient if the surface temperature is represented by the arithmetic mean of its inlet and outlet values.

(b) Determine the outlet temperature of the water.