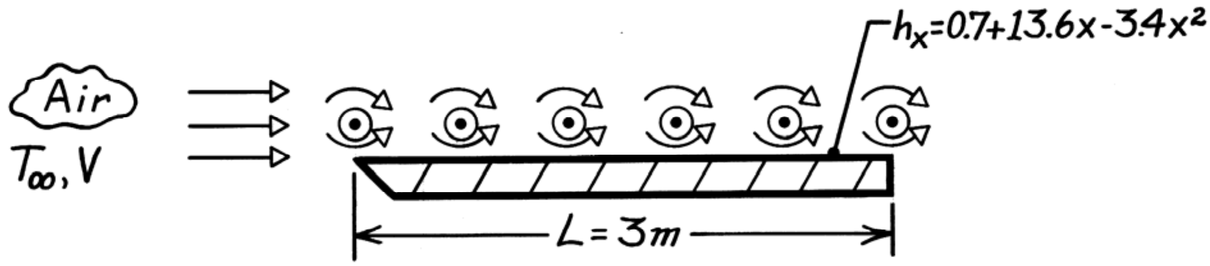
PROBLEM 6.7

KNOWN: Distribution of local convection coefficient for obstructed parallel flow over a flat plate.

FIND: Average heat transfer coefficient and ratio of average to local at the trailing edge.

SCHEMATIC:



ANALYSIS: The average convection coefficient is

$$\bar{h}_L = \frac{1}{L}\int_0^L h_x dx = \frac{1}{L}\int_0^L \left(0.7+13.6x-3.4x^2\right)dx$$

$$\bar{h}_L = \frac{1}{L}\left(0.7L+6.8L^2-1.13L^3\right) = 0.7+6.8L-1.13L^2$$

$$\bar{h}_L = 0.7+6.8(3)-1.13(9) = 10.9\ \text{W/m}^2\cdot\text{K}. \qquad <$$

The local coefficient at x = 3m is

$$h_L = 0.7+13.6(3)-3.4(9) = 10.9\ \text{W/m}^2\cdot\text{K}.$$

Hence,

$$\bar{h}_L / h_L = 1.0. \qquad <$$

COMMENTS: The result $\bar{h}_L / h_L = 1.0$ is unique to x = 3m and is a consequence of the existence of a maximum for $h_x(x)$. The maximum occurs at x = 2m, where $\left(dh_x/dx\right)=0$ and $\left(d^2h_x/dx^2 < 0.\right)$