P7.26 Consider laminar flow past the square-plate arrangements in the figure below. Compared to the drag of a single plate (1), how much larger is the drag of four plates together as in configurations (a) and (b)? Explain your results.

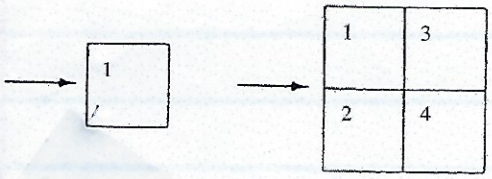

Fig. P7.26 (a)

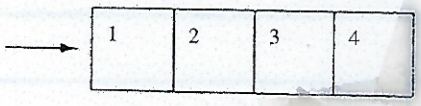

Fig. P7.26 (b)

P7.35 Repeat Problem 7.26 for *turbulent* flow. Explain your results.

(a) laminar flow $C_D = \dfrac{D}{\frac{1}{2}\rho U^2 A}$

$C_D = 1.328 / \sqrt{\frac{UL}{\nu}} \propto L^{-1/2}$

$D_1 = \frac{1}{2}\rho U^2 A_1 \times 1.328/\sqrt{\frac{UL}{\nu}}$ $\quad A_1 = L^2$

$D_2 = \frac{1}{2}\rho U^2 A_2 \times 1.328/\sqrt{\frac{U2L}{\nu}}$ $\quad A_2 = 4L^2$

$D_3 = \frac{1}{2}\rho U^2 A_3 \times 1.328/\sqrt{\frac{U4L}{\nu}}$ $\quad A_3 = 4L^2$

$D_2/D_1 = \sqrt{8}$ ie $D_2 = 2.83 D_1$ $\quad D_3/D_1 = 2$ $\quad D_3 = 2D_1$

(b) turbulent flow $C_D = .031/Re_L^{1/7} \propto L^{-1/7}$

$D_1 = \frac{1}{2}\rho U^2 A_1 \times .031/\left(\frac{UL}{\nu}\right)^{1/7}$

$D_2 = \frac{1}{2}\rho U^2 A_2 \times .031/\left(\frac{U2L}{\nu}\right)^{1/7}$

$D_3 = \frac{1}{2}\rho U^2 A_3 \times .031/\left(\frac{U4L}{\nu}\right)^{1/7}$

$D_2/D_1 = 2^{13/7} = 3.62$ $\quad D_3/D_1 = 3.28$

$D_2 \sim 4 \times D_1$ $\quad D_3 \sim 3 \times D_1$