December 5, 2012

NAME

Fluids-ID

Quiz 16. The structure shown in the figure consists of three cylindrical support posts to which an elliptical flat plate sign (area is $39.3 ft^2$) is attached. Estimate the drag on the structure when a 73.3 ft/s wind blows against it (flow direction is into the paper).

(Note: $\rho = 0.00238 \, slugs/ft^3$)

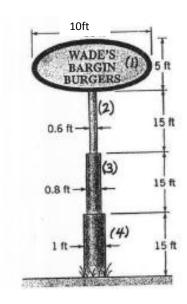
For a Drag,

$$Drag = \frac{1}{2}\rho C_D U^2 A_p$$

where A_p is the projected area to the wind direction.

 C_D corresponding to each part are given as blow:

C_D
1.1
0.6
0.5
0.25



Solution:

For the composite body

$$D = \sum D_i = \frac{1}{2} \rho U^2 \left[C_{D_1} A_1 + C_{D_2} A_2 + C_{D_3} A_3 + C_{D_4} A_4 \right]$$

(+4 points)

where

$$A_1 = 39.3 ft^2$$

$$A_2 = (0.6 ft)(15 ft) = 9.00 ft^2$$

$$A_3 = (0.8 ft)(15 ft) = 12.0 ft^2$$

$$A_4 = (1.0 ft)(15 ft) = 15.0 ft^2$$

(+4 points)

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Thus,

$$D = \frac{1}{2} \left(0.00238 \frac{slugs}{ft^2} \right) \left(73.3 \frac{ft}{s} \right)^2 \left[1.1 \times 39.3 + 0.6 \times 9.0 + 0.5 \times 12.0 + 0.25 \times 15.0 \right]$$

$$= 373 \ lbs$$
(+2 points)