

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: $\rho = 0.00238 \text{ slugs/ft}^3$)

For a Drag,

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

where A_p is the projected area to the wind direction.

C_D corresponding to each part are given as blow:

Shape	C_D
Elliptical flat plate sign (1)	1.1
Cylinder (2)	0.6
Cylinder (3)	0.5
Cylinder (4)	0.25



Solution:

For the composite body

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

(+4 points)

where

$$A_1 = 39.3 \text{ ft}^2$$

$$A_2 = (0.6 \text{ ft})(15 \text{ ft}) = 9.00 \text{ ft}^2$$

$$A_3 = (0.8 \text{ ft})(15 \text{ ft}) = 12.0 \text{ ft}^2$$

$$A_4 = (1.0 \text{ ft})(15 \text{ ft}) = 15.0 \text{ ft}^2$$

(+4 points)

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Thus,

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

$= 373 \text{ lbs}$
(+2 points)