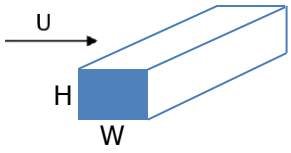
DRAG ON 2D BODIES

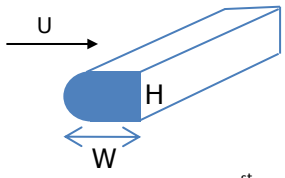
LIFT & DRAG SELF ASSESSMENT SHEET 1

1. A very long cylinder, H=5 cm high and W=30 cm wide, is immersed in water (density 1000 kg/m^3, viscosity =0.001 kg/ms) flowing at 12 m/s parallel to the long side of the rectangular cross-section. Estimate the drag force on the cylinder per unit width if the rectangle has: a) a flat rectangular face, or b) a rounded nose.

Illustration (not in scale): a)



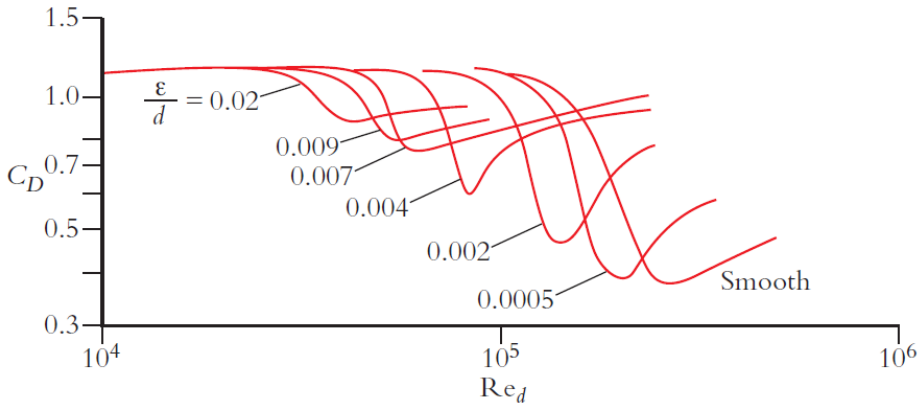
b)



Ans: a) 3240 N/m b) 2304 N/m

(The above answers are for U=12 m/s. If you used U=8.5 m/s which was erroneously given in the 1st version of this example sheet, then you would get: a) 1626 N/m and b) 1156 N/m).

2. A circular cylinder is in a flow of water (density 1000 kg/m^3, kinematic viscosity 10^{-6} m^2/s) moving at 0.9 m/s. It is observed that there is a reduction in drag just below Re = 10^5. What diameter does the cylinder have and what is the mean roughness height.



Ans: diameter 0.11m, 0.44mm

3. A fishnet consists of 1mm diameter strings overlapped and knotted to form 1cmx1cm squares. Estimate the drag of 1 m^2 of such a net when towed normal to its plane at 3m/s in seawater (density 1025 kg/m^3 and viscosity 0.00107 kg/ms) given that transition to turbulence occurs at around 10^5 for a long circular cylinder. What power is required to tow 400 ft^2 of this net?

Ans: 1119 N (or 1108 N if 2 end threads neglected), 124 kW

4. At a Reynolds number of 20,000 a NACA 4412 airfoil mounted in a wind tunnel has a drag coefficient of 0.055. If the chord length is 350mm, what speed is the air moving past the airfoil? Take the properties of air to be density 1.2 kg/m^3 and viscosity 1.8x10^{-5} kg/ms.

Ans: 0.86 m/s.