Fluid mechanics

Instruction 6

Week 6

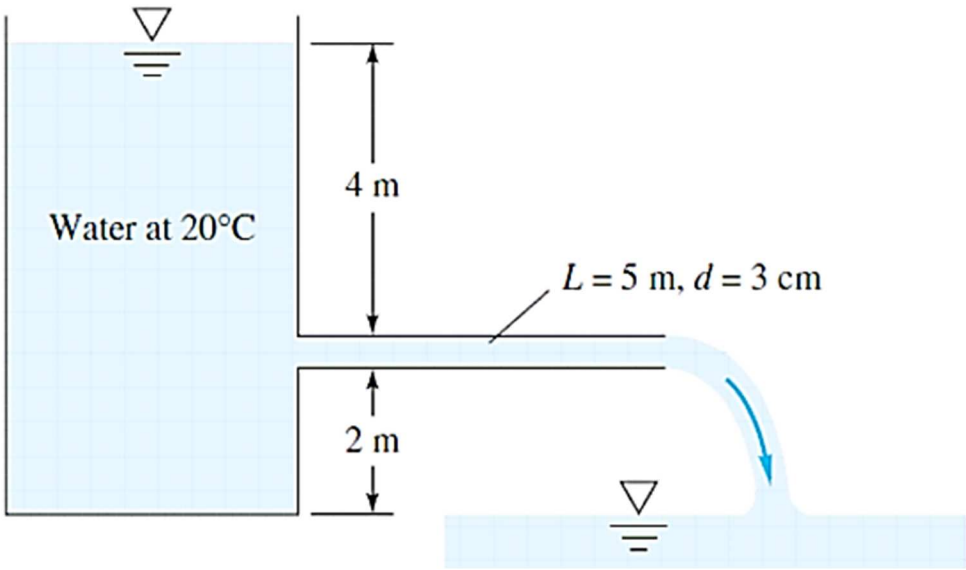
Van onderstaande vraagstukken zal tijdens de instructie er een aantal behandeld worden. Het is een goede voorbereiding er doorheen te kijken, en te proberen of je ze zelf kan oplossen.

Let op: vraagstuknummering is niet altijd uniform door de verschillende edities van ‘White’.

Bron: alle opgaven komen van het boek *Fluid Mechanics* van Frank M. White (McGraw-Hill Series in Mechanical Engineering)

Pijpstroming

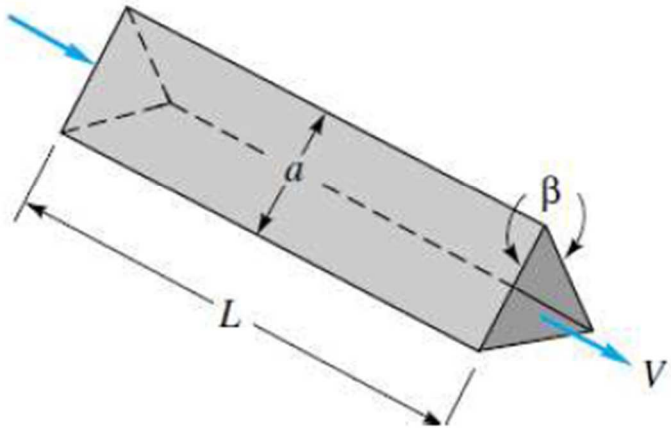
The tank-pipe system of Fig. P6.49 is to deliver at least 11 m^3/h of water at 20°C to the reservoir. What is the maximum roughness height ϵ allowable for the pipe?



a) Zonder instroom- of uitstroomverliezen.
b) Uitgaande van een mooi afgeronde inlaat.
c) Voor de rechthoekige inlaat zoals geschetst.
d) Bediscussieer de relevantie van ‘stroomlijning’ van deze buisinlaat; bijvoorbeeld aan de hand van een schets van de stroming ter plekke.
e) Heeft een 1:2 diffusor op de uitlaat een gunstig effect?

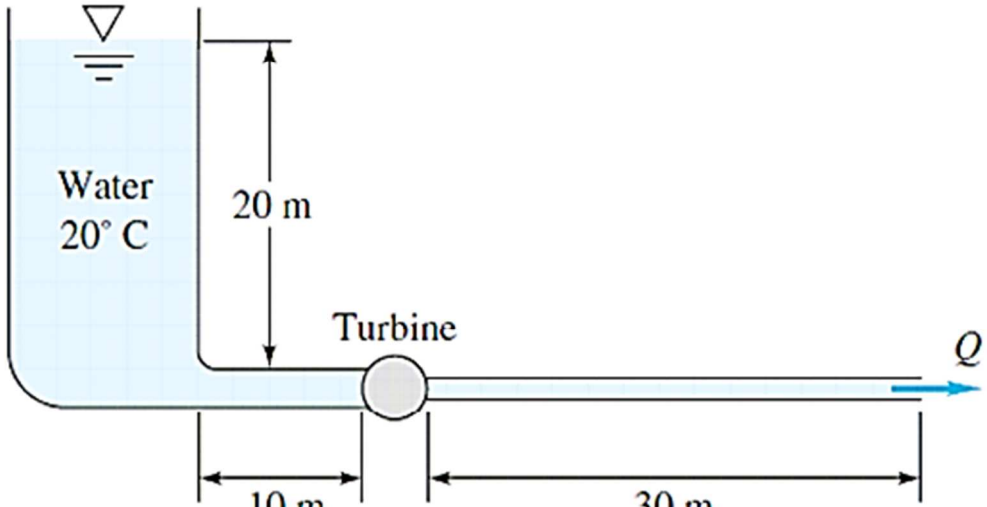
Pijpstroming

P6.91 Heat exchangers often consist of many triangular passages. Typical is Fig. P6.91, with $L = 60$ cm and an isosceles-triangle cross section of side length $a = 2$ cm and included angle $\beta = 80°$. If the average velocity is $V = 2$ m/s and the fluid is SAE 10 oil at 20°C, estimate the pressure drop.



Energievergelijking

P6.76 The small turbine in Fig. P6.76 extracts 400 W of power from the water flow. Both pipes are wrought iron. Compute the flow rate Q m^3/h. Sketch the EGL and HGL accurately.



P6.76

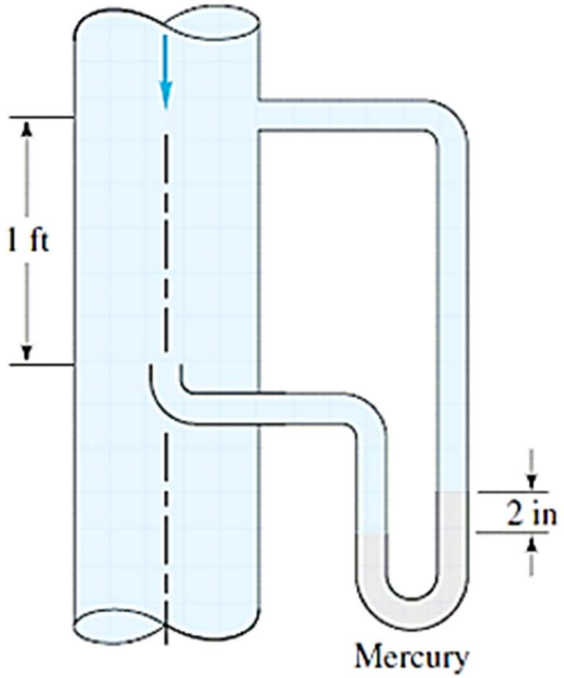
Klein verlies

P6.131 A water-tunnel test section has a 1-m diameter and flow properties $V = 20$ m/s, $p = 100$ kPa, and $T = 20°C$. The boundary-layer blockage at the end of the section is 9 percent. If a conical diffuser is to be added at the end of the section to achieve maximum pressure recovery, what should its angle, length, exit diameter, and exit pressure be?

P6.132 For Prob. 6.131 suppose we are limited by space to a total diffuser length of 10 m. What should the diffuser angle, exit diameter, and exit pressure be for maximum recovery?

Flow meting

P6.137 For the 20°C water flow of Fig. P6.137, use the pitot-static arrangement to estimate (*a*) the centerline velocity and (*b*) the volume flow in the 5-in-diameter smooth pipe. (*c*) What error in flow rate is caused by neglecting the 1-ft elevation difference?



P6.137

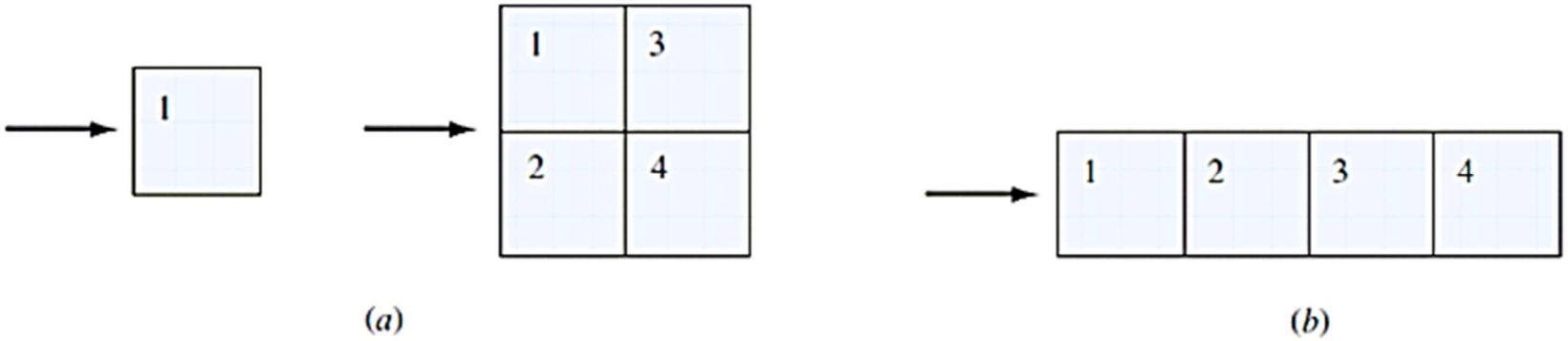
Grenslagen

P7.1 For flow at 20 m/s past a thin flat plate, estimate the distances x from the leading edge at which the boundary-layer thickness will be either 1 mm or 10 cm for (a) air and (b) water at 20°C and 1 atm.

a) Bedenk dat je nog niet weet of de stroming laminair of turbulent is.
b) Schets de stroming op de gegeven positie x.

Grenslagen

P7.26 Consider laminar boundary-layer flow past the square-plate arrangements in Fig. P7.26. Compared to the friction 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.



Grenslagen

P7.36 A ship is 125 m long and has a wetted area of 3500 m^2. Its propellers can deliver a maximum power of 1.1 MW to seawater at 20°C. If all drag is due to friction, estimate the maximum ship speed, in kn.

Hint: Een ‘kn’ is uiteraard geen kilo-newton, maar een knot = ‘knoop’.
1 knoop = 1 nmi/hr = 1 nautic mile / hour = 1 zeemijl per uur
1 zeemijl = 10 kabellengtes = 1852 meter.

Aerodynamica

P7.57 The main cross-cable between towers of a coastal suspension bridge is 60 cm in diameter and 90 m long. Estimate the total drag force on this cable in crosswinds of 50 mi/h. Are these laminar-flow conditions?

Aerodynamica

P7.62 A sea-level smokestack is 52 m high and has a square cross section. Its supports can withstand a maximum side force of 90 kN. If the stack is to survive 90-mi/h hurricane winds, what is its maximum possible width?