

Chapter 2 : Pressure and Head

- 2.1 a. From eqn. 2.4 : $p_2 - p_1 = -\rho g(z_2 - z_1)$ and taking sea level as datum point 1, then :
 $p_1 = 0 \text{ Nm}^{-2}$, $\rho = 1002 \text{ kgm}^{-3}$, $g = 9.81 \text{ ms}^{-2}$, $z_2 = -2000 \text{ m}$ and $z_1 = 0 \text{ m}$.
 $\Rightarrow p_2 - 0 = -1002 \times 9.81 \times (-2000 - 0)$, $\therefore p_2 = 19.66 \text{ MNm}^{-2}$

- b. From eqn. 1.12, we know $K = \rho \frac{dp}{dz}$ and from eqn. 2.17, $p = \rho g z$ giving :

$\rho^2 g dz = K dp$. If it is assumed that z is measured from the surface and is negative as depth increases, and that K is constant over small pressure ranges, we can then integrate

$$\int_{z_1}^{z_2} \frac{g}{K} dz = - \int_{p_1}^{p_2} \frac{1}{\rho^2} dp \Rightarrow \left[\frac{gz}{K} \right]_{z_1}^{z_2} = \left[\frac{1}{\rho} \right]_{p_1}^{p_2}$$

Since we know that $z_1 = 0 \text{ m}$ then, $\frac{gz}{K} = \frac{1}{\rho_2} - \frac{1}{\rho_1} \Rightarrow p_2 = \frac{K\rho_1}{\rho_1 g z + K}$

Integrating, NB $\int \frac{1}{1+ax} dx = \frac{1}{a} \ln(1+ax)$

$$\Rightarrow p_2 - p_1 = -\rho g \frac{K}{\rho_1 g} \ln \left[1 + \frac{\rho_1 g z}{K} \right]_{z=0}^{z_2} \Rightarrow p_2 - p_1 = -K \ln \left(1 + \frac{\rho_1 g z_2}{K} \right)$$

We know that $p_1 = 0 \text{ Nm}^{-2}$, $K = 2.05 \times 10^9 \text{ Nm}^{-2}$, $\rho_1 = 1002 \text{ kgm}^{-3}$ and $z_2 = -2000 \text{ m}$, hence :

$$p_2 - 0 = -2.05 \times 10^9 \ln \left[1 + \frac{1002 \times 9.81 \times (-2000)}{2.05 \times 10^9} \right] \therefore p_2 = 19.75 \text{ MNm}^{-2}$$

- 2.2 a. From eqn. 2.4 : $p_2 - p_1 = -\rho g(z_2 - z_1)$. Taking the free surface as datum point 1 then, $p_1 = 0 \text{ Nm}^{-2}$, $\rho = 1000 \text{ kgm}^{-3}$, $g = 9.81 \text{ ms}^{-2}$, $z_2 = -12 \text{ m}$ and $z_1 = 0 \text{ m}$.
 $\therefore p_2 = 117.72 \text{ kNm}^{-2}$
- b. From eqn. 2.16 : $p = \rho gh + p_{\text{atm}}$, ie Absolute pressure = Gauge pressure + Atmospheric pressure. Here, gauge pressure = 117720 Nm^{-2} and atmospheric pressure = 101000 Nm^{-2} , \therefore **Absolute pressure = 218.72 kNm^{-2}**

- 2.3 a. Specific gravity of oil = $\frac{\rho_{\text{oil}}}{\rho_{\text{H}_2\text{O}}} \Rightarrow 0.8 = \frac{\rho_{\text{oil}}}{1000} \Rightarrow \rho_{\text{oil}} = 800 \text{ kgm}^{-3}$

From eqn. 2.17 : $p = \rho gh$, where $p = 120 \times 10^3 \text{ Nm}^{-2}$, $\rho = 800 \text{ kgm}^{-3}$, $g = 9.81 \text{ ms}^{-2}$, $\Rightarrow 120 \times 10^3 = 800 \times 9.81 \times h$, $\therefore h = 15.3 \text{ m}$

- b. As before, $p = 120 \times 10^3 \text{ Nm}^{-2}$ and $g = 9.81 \text{ ms}^{-2}$, however, $\rho = 1000 \text{ kgm}^{-3}$.

From eqn. 2.17 : $p = \rho gh \Rightarrow 120 \times 10^3 = 1000 \times 9.81 \times h$

$\therefore h = 12.2 \text{ m}$

- 2.4 We know that $1 \text{ bar} = 1 \times 10^5 \text{ Nm}^{-2}$.

From eqn. 2.4 : $p_2 - p_1 = -\rho g(z_2 - z_1)$. Taking the free surface as datum point 1 :
 $p_2 = 1 \times 10^5 \text{ Nm}^{-2}$, $p_1 = 0 \text{ Nm}^{-2}$, $\rho = 600 \text{ kgm}^{-3}$, $g = 9.81 \text{ ms}^{-2}$ and $z_1 = 0 \text{ m}$.

Douglas Fluid Mechanics Solution Manual

Mohamed Gadala



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Fluid Mechanics John F. Douglas, 2005 Written for courses in Fluid Mechanics in Civil and Mechanical Engineering this text covers the fundamental principles of fluid mechanics as well as specialist topics in more depth The fundamental material relates to all engineering disciplines that require fluid mechanics As in previous editions this book demonstrates the link between theory and practice with excellent examples and computer programs The programs help students perform 3 types of calculations relatively simple calculations calculations designed to provide solutions for steady state system operation and unsteady flow simulations *Catalog of Copyright Entries. Third Series* Library of Congress. Copyright Office, 1963 Includes Part 1 Number 1 Books and Pamphlets Including Serials and Contributions to Periodicals January June

Applied Mechanics Reviews, 1986 *Basic Fluid Mechanics and Hydraulic Machines* Zueb Husain, Zulkifly Abdullah, Zainal Alimuddin, 2009-02-27 Following a concise overview of fluid mechanics informed by numerous engineering applications and examples this reference presents and analyzes major types of fluid machinery and the major classes of turbines as well as pump technology It offers professionals and students in hydraulic engineering with background concepts as well as practical coverage of modern turbine technologies fully explaining the advantages of both steam and gas turbines Description design and operational information for the Pelton Francis Propeller and Kaplan turbines are provided as are outlines of various types of power plants It provides solved examples chapter problems and a thorough case study Books and Pamphlets, Including Serials and Contributions to Periodicals Library of Congress. Copyright Office, 1968 The Finite Element Method in Heat Transfer and Fluid Dynamics, Third Edition J. N. Reddy, D.K. Gartling, 2010-04-06 As Computational Fluid Dynamics CFD and Computational Heat Transfer CHT evolve and become increasingly important in standard engineering design and analysis practice users require a solid understanding of mechanics and numerical methods to make optimal use of available software The Finite Element Method in Heat Transfer and Fluid Dynamics Third Edition illustrates what a user must know to ensure the optimal application of computational procedures particularly the Finite Element Method FEM to important problems associated with heat conduction incompressible viscous flows and convection heat transfer This book follows the tradition of the bestselling previous editions noted for their concise explanation and powerful presentation of useful methodology tailored for use in simulating CFD and CHT The authors update research developments while retaining the previous editions key material and popular style in regard to text organization equation numbering references and symbols This updated third edition features new or extended coverage of Coupled problems and parallel processing Mathematical preliminaries and low speed compressible flows Mode superposition methods and a more detailed account of radiation solution methods Variational multi scale methods VMM and least squares finite element models LSFEM Application of the finite element method to non isothermal flows Formulation of low speed compressible flows With its presentation of realistic applied examples of FEM in thermal and fluid design analysis this proven masterwork is an invaluable tool for mastering basic methodology competently

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web as bee populations worldwide face alarming population declines public awareness of the centrality of bees to the life cycle of plants is rapidly growing the time couldn t be better for a major piece of educational artwork designed to help people understand the lives and social structures of the hive

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web triggered by vibration sensors within a real beehive the sound and light intensity within the pavilion increases as the energy levels in the living hive surge giving visitors an incredible

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wildflower meadow the structure is called the hive a 17 meter tall ode to

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web it stands at 17 metres tall there aren't any real honeybees around it but many humans find themselves sucked into the hive at kew it is a striking insta

kew gardens wikipedia - Feb 13 2023

web the hive the hive opened in 2016 and is a multi sensory experience designed to highlight the extraordinary life of bees it stands 17 metres 56 ft tall and is set in a wildflower meadow the hive was designed by english artist wolfgang buttress the hive has been created using thousands of aluminium pieces that are presented in the shape of

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web jun 20 2016 designed by wolfgang buttress the hive is now at kew gardens strolling around kew gardens you'll catch a glimpse of a large swarm of bees in the distance it is in fact the hive a giant honeycomb structure standing 17 metres tall surrounded by a wildflower meadow it beckons you forth with its twinkling lights

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web author rbg kew 96pp 250 x 250mm colour photographs and illustrations throughout paperback with fold out flaps isbn 9781842466254 kew publishing 2016 the hive was the centrepiece of the gold medal winning uk pavilion at the 2015 milan expo and from june 2016 takes up its new home within kew gardens

real bees drive the hive experience kew - Aug 19 2023

web may 24 2017 the hive is a unique immersive experience connecting you to real bees in a beehive at kew but how does it work an accelerometer sits in a beehive at kew accelerometers are vibration sensors this accelerometer picks up vibrations from activity of the bees and these vibrations are sent in real time to the hive lights in the hive

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web dec 22 2022 heinemann to unveil the hive of wonders pop up campaign at istanbul airport three pop ups were launched at the airport running through november and december the striking animations highlight guerlain's l'art la matière and aqua allegoria fragrance lines alongside its abeille royale skincare collection and holiday

the hive kew - Sep 20 2023

web at a towering 17 metres tall the hive is a striking installation in the heart of a wildflower meadow that recreates life inside a beehive a stunning piece of contemporary art it s one of the most photographed spots in the gardens

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web jun 17 2016 bees the sculpture controlled by bees wolfgang buttress s hive its 170 000 pieces of aluminium are a hive like structure of latticework controlled by the vibrations of honeybees in a

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