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MET 330

1. The test requires the calculation of forces on a flange and the piezometric head which directly involves understanding fluid properties like density and static pressure distribution. These concepts are fundamental to fluid mechanics and their application signifies the fulfillment of learning objectives related to understanding basic fluid properties and how they influence forces in static fluid systems. Calculating the pressure drop across a flow nozzle involves applying Bernoulli's equation and the continuity equation, which are core principles of fluid dynamics. Determining the forces in a pipe-elbow system, including free-body diagrams, requires an understanding of how fluid flow can impose forces on system boundaries. This reflects learning objectives centered around the analysis of fluid flow in different systems and the resultant forces. Addressing water hammer, cavitation, and pipe thickness necessitates an integration of fluid mechanics theories with practical design considerations. This aspect of the test focuses on the design, evaluation, and troubleshooting of fluid systems under dynamic conditions. The section of the test that deals with designing a lazy river introduces real-world engineering applications of fluid mechanics principles, emphasizing objectives related to applying theoretical knowledge to practical engineering problems, such as the design of recreational water facilities.

2. Upon reviewing the solutions provided, I recognize that I made a mistake in calculating the force magnitude for the blind flange (Q1). I misunderstood the relationship between pressure and force over an area. In the future, I will ensure to review the fundamentals of pressure-force-area relationships before attempting the problem. For computing the horizontal and vertical forces (Q2) I used the incorrect value for the pressure in the right tank, because I used the same value for it as the one from the last test as I was under the impression that it was the same problem. I realize that I should have used Bernoulli's to find that pressure and then used that value to compute Rx and Ry to get the total values for the vertical and horizontal forces. For the water hammer pressure increase (Q4), I did not account for the modulus of elasticity correctly, affecting the calculation. To avoid this, I will create a checklist of all variables and their correct units before starting a problem. For Part B, when calculating the drag force, I should have created a model or diagram to clearly define the child's dimensions as a cylinder, use the correct drag equation, and ensure the flow rate calculated previously is accurately applied. Also, when computing the drag coefficient (C_D) I neglected to find the Reynold's number found in fig 17.4 leading me to incorrectly calculate the drag force as well. In the future for tests, I will take time to fully understand what each question asks before attempting to solve it. This includes identifying what assumptions need to be made. I also must ensure that I'm applying the correct equations for each part of the problem and double-checking to ensure all units are consistent and correctly applied.

3. <u>WRITING RUBRIC (Applied to the whole test, not to particular problems)</u>
    1. Purpose 0.5/10.0 out of 0.5/10.0
    2. Drawings 0.5/10.0 out of 1.0/10.0

3. Sources 1.0/10.0 out of 1.0/10.0
4. Design considerations 1.0/10.0 out of 1.0/10.0
5. Data and variables 0.5/10.0 out of 0.5/10.0
6. Procedure 1.0/10.0 out of 2.0/10.0
7. Calculations 0.5/10.0 out of 2.0/10.0
8. Summary 0.5/10.0 out of 0.5/10.0
9. Materials 0.5/10.0 out of 0.5/10.0
10. Analysis 1.0/10.0 out of 1.0/10.0

    TOTAL = **7.0/10.0** out of 10.0/10.0

1. Force on the flange
    a. Consider piezometric head (get pressure above fluid) 0.0/25 out of 1/25
    b. Force magnitude 0.5/25 out of 1/25
    c. Force location 0.5/25 out of 1/25
2. Pipe-elbow forces
    a. Free body diagram and correct forces 0.5/25 out of 1/25
    b. Force in x – solve for Rx 0.0/25 out of 1/25
    c. Force in y (weight) – solve for Ry 0.5/25 out of 1/25
3. Flow-nozzle flowmeter pressure drop
    a. Right equation and A1/A2 1/25 out of 1/25
    b. C value 0.0/25 out of 1/25
4. Water hammer pressure increase and cavitation
    a. Wave velocity (units?) 0.0/25 out of 1/25
    b. Pressure increase and Pmax 0.5/25 out of 1/25
    c. Pipe thickness 1/25 out of 1/25
    d. Lowest pressure & compare to sat pressure (cavit) 1/25 out of 1/25
5. Flow in the open channel
    a. Lazy river dimensions 1/25 out of 1/25
    b. Correct equation 1/25 out of 1/25
    c. Area and hydraulic radius 0.0/25 out of 1/25
6. Drag force on the child
    a. Correct equation to use 1/25 out of 1/25
    b. Correct area and velocity 0.0/25 out of 1/25
    c. How Cd was obtained? 0.0/25 out of 1/25
7. Lazy river tube floating – stability
    a. Realize Fb=W and solve for distance into water 1/25 out of 1/25
    b. Compute metacenter location 0.0/25 out of 1/25
    c. Realize metacenter will always be above cg 1/25 out of 1/25

8. Correct results? 1/25 out of 4/25

    Total = **11.5/25 out of 25/25**

FINAL GRADE:

7 + (80)*(11.5/25) = 43.8

4. Some issues I encountered were misunderstanding the relationship between pressure and force over an area, using incorrect values, and neglecting important variables like the modulus of elasticity. Realizing the need for a thorough review of fundamental concepts and ensuring a clear understanding of the problem statements and required assumptions before attempting solutions. Something I can change would be to create a checklist of variables and assumptions before starting a problem to prevent similar mistakes in the future. This test helped me learn more about concepts such as basic fluid properties, Bernoulli's equation, the continuity equation, free-body diagrams in fluid mechanics, and practical design considerations such as addressing water hammer and cavitation. The concepts touched upon in the test are used in designing and managing systems where fluid flow is critical. Examples include water distribution systems, hydraulic design, and safety measures against water hammer in pipelines. Some applications of the learned concepts would be the real-world engineering problems, such as the design of recreational water facilities, indicating an understanding of how theoretical principles are applied practically. Understanding fluid mechanics is essential for many engineering fields such as mechanical, civil, and environmental engineering especially in design and analysis of systems involving fluid flow. I spent numerous days and hours on this test, where most of that time was used just to comprehend the directions and what was being asked for each problem. This led to a lot of time being wasted and be ultimately poor organization of my time throughout the test. In the future, I should start on the areas I know the best and try to write down all relevant or given data first and use that to better grasp what was being asked of me. Also, I noticed in the solution the use of excel sheets to better organize the data, which I did not implement for my test. I feel as this would greatly benefit me in both the organizational aspect, as well as the overall accuracy of my solutions, so this will be something that I implement in the future.