MET 330
Test 2 Reflection
Chris Betton

**1)How and why the test demonstrates your work toward one, or more, of the course learning objectives. Be specific on the course objectives you decide to mention.**

Overall this test satisfied the objective of solving specific industrial problems such as, open channel flow, cavitation, water hammer, drag lift and forces in pipes. This can be seen in all parts of the test. For example, in part d it was required to assess the possibility for water hammer and cavitation in the system. Also, in part a of the test it was required to calculate natural flow in the open channel and compare this with the volumetric flow rate of water being removed by the system. The course objective to compute forces in a pipe was covered in part b. Part b of the test required calculations of the forces exerted by the fluid on the piping it flowed through. This test also required knowledge of fluid flow through pipes and fittings and built on the objective of explaining fluid dynamics in pipes and fittings. This is evident throughout the test when it was necessary to consider K values (friction losses) of various fittings and pipes.

**2) How your test compares against the available solution. State the mistakes you made and what you will do next time to avoid making same mistakes. Please point out exactly where you made the mistake, say why you made the mistake, and how you should have done it. If you were taking this test again, what advice would you give yourself to ensure that you had a successful test?**

Part a: no mistakes

Part b: In part b my mistake was trying to calculate the forces felt in the individual sections of the discharge piping. Instead, I should have considered the discharge piping as a whole. I believe my equation manipulation was correct based on my approach to the problem. I did not have adequate information to solve the problem with the approach I took which shows that I was approaching the problem the wrong way. I should have calculated the pressure at the pump discharge while considereing the losses from the pipe, elbows and valve. Then I should have calculated the sum of forces in the x and y direction. I was also unsure how to calculate the weight of the fluid. In the test solution I see that weight of fluid is the specific weight multiplied by the volume.

Part c: I correctly solved for dynamic pressure but did not calculate the new pump head after solving for the dynamic pressure. I should have considered the energy losses due to the new pump head and added this to the previously calculated energy losses. The comparison between the previous and new energy losses would have provided a percentage of necessary change for the power of the pump.

Part d: I used equation 11-9 incorrectly and did not solve for water hammer. I should have checked the system for possible water hammer and cavitation failure by doing the following. Compute the water hammer overpressure, then copute the max pressure. Then use that

pressure to compute pipe thickness using the equation 11-9. To check for cavitation, I should hav computed the pressure at the inlet of the pump and compared this value with water saturation pressure at 60F.

Part e: In this section the correct approach would be to design a buoy system that drags a gate shut to stop the water level from exceeding 38 inches. To do this I would calculate the moment due to buoyancy of the buoy and ensure that this is designed to be greater than the buoyancy due to hydrostatic pressure on the gate. The circular gate would open due to the moment of pressure being less than the moment due to buoyancy. It is also important to note that the buoy would be stable because the center of buoyancy is located at the buoy center of mass.

Part f: To find out what the proper weight to allow for an object to move across the bottom of the open channel, I should have calculated the drag force and set an equilibrium condition to friction force.

Part g: The proper way to create an excel spreadsheet that would perform the necessary calculations for this test would be to insert the known variables into a spreadsheet. Then I would use excel's equation editor to manipulate the variables to find my unkowns. Excel can be used to find theoretical data as well. For example, the left and right side of an equation can be simulated with experimental data to find the most reasonable results.

**3) What your grade should be. Base it on the writing rubric provided in the test and the correctness of your solution. What are the strengths and weaknesses of your test?**

WRITING RUBRIC (APPLIES TO THE WHOLE TEST, NOT TO PARTICULAR PARTS)

| | |
|---|---|
| 1. Purpose | 0.5/10.0 out of 0.5/10.0 |
| 2. Drawings | 1.0/10.0 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 | 2.0/10.0 out of 2.0/10.0 |
| 7. Calculations | 1.0/10.0 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 | 0.5/10.0 out of 1.0/10.0 |
| TOTAL WRITING RUBRIC | 10.0/10.0 out of 10.0/10.0 |

PART 1)

| | |
|---|---|
| 1. Correct equation | 1/4 out of 1/4 |
| 2. Area calculation | 1/4 out of 1/4 |
| 3. Hydraulic radius calculation | 1/4 out of 1/4 |
| 4. Correct results? | 1/4 out of 1/4 |

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PART 2)

1. Free body diagram and correct forces 1/4 out of 1/4
2. Force in x 1/4 out of 1/4
3. Force in y (weight) 1/4 out of 1/4
4. Correct results? 0/4 out of 1/4

PART 3)

1. Right equation and A1/A2 1/3 out of 1/3
2. C value 1/3 out of 1/3
3. Correct results? 1/3 out of 1/3

PART 4)

1. Water hammer
    a. Wave velocity (units?) & pressure increase 0/4 out of 1/4
    b. Operating pressure & pipe thickness 1/4 out of 1/4
2. Cavitation
    a. Lowest pressure & compare to sat pressure 0/4 out of 1/4
3. Correct results? 0/4 out of 1/4

PART 5)

1. Hydrostatic force on the gate
    a. Magnitude 0/5 out of 1/5
    b. Location 0/5 out of 1/5
2. Solve for buoy force with moment conservation 0/5 out of 1/5
3. Using buoyancy, get sphere diameter. 0/5 out of 1/5
4. Correct results? 0/5 out of 1/5

PART 6)

1. Correct area 0/4 out of 1/4
2. Correct velocity 0/4 out of 1/4
3. How Cd was obtained? 0/4 out of 1/4
4. Correct results? 0/4 out of 1/4

PART 7)

1. Setting up the spreadsheet for all parts 0/3 out of 1/3
2. Case for flow rate when the pump power is half 0/3 out of 1/3
3. Correct results? 0/3 out of 1/3

FINAL GRADE:

**10.0 + (80/7)*(4/4 + 3/4 + 3/3 + 1/4 + 0/5 + 0/4 + 0/3) = 44** (if everything is correct)

**4) Discuss the following:**

**a.What issues did you encounter in completing the test? How did you troubleshoot them?**

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In this test I encountered issues when deciding if data could be used from calculations in test one or if certain calculations that were necessary on both tests needed to be shown on test two. I asked the professor for assistance on this matter and he gave me clarification.

**b.What steps did you take to complete the whole test? Would you change something?**

To complete this test, I read the entire test prompt then made a system drawing. Next, I started solving each part of the test sequentially. In hindsight, I should have gathered all my known variables from test one prior to solving anything on this test. I wasted a significant amount of time recalculating things from the first test. I also could print out the required tables and charts for the data that is gathered from those locations. I think it would be a lot easier to quickly parse through charts in tables on paper rather than click through a virtual textbook. Lastly, I would obtain excel calculations after each step of the problem instead of waiting until the end. This would allow me to check my work as I go and complete the tasks in a more suitable fashion for a customer or coworker in the real world. It would be a lot easier to show progress on a project with excel data rather than showing hand calculations.

What I learned on this test:

In this test I learned more about the force of buoyancy and how it can be used in mechanical systems. I also learned more about fluid dynamics in open channel flows. I learned that natural flows can be calculated very similarly to flow rate of a man-made system. The concepts I learned in this test can be applied to a variety of applications and relates very much with some of my other courses. For example, the forces exerted on the piping system by the fluid flowing in them can cause stress on the pipes. Calculating stress in piping and other rigid members relates to strength of materials. It is also important to calculate. These concepts relate to water storage tanks and flow from those tanks. It also applies to systems that need to control water level in nature. This is vital with the current state of global water level rise. It will be engineers using tools of fluid mechanics that will need to find solutions to such problems.