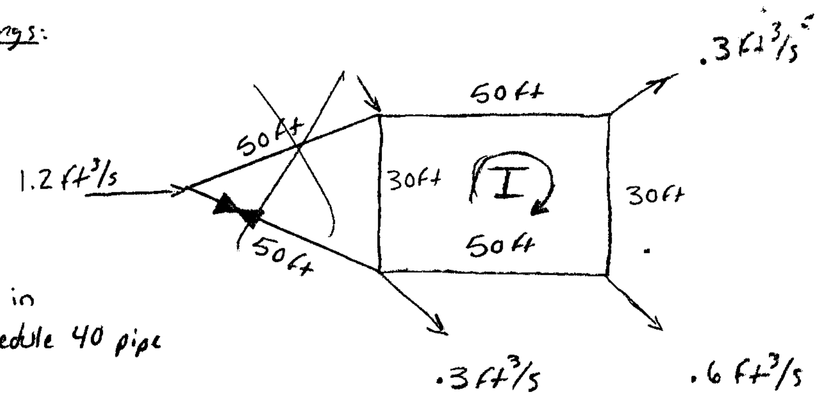
Problem 1	Test 3	Dezmond Banks

Purpose: Find the flow rate in each pipe. neglect minor loses

Drawings:



Sources: - Mott & Untener. Applied Fluid Mechanics 7th edition. Pearson 2015
- Blackboard lectures & HW Solutions

Design Considerations:

- incompressible fluid
- water @ 60°F
- Valve fully closed
- 1 circuit
- neglect minor losses

Data and variables:

- $\gamma_{H_2O} = 62.4\ \text{lb/ft}^3$
- $\nu = 1.21 \times 10^{-5}\ \text{ft}^2/\text{s}$
- $2\frac{1}{2}$ in schedule 40 pipe
- $\frac{P_A}{\gamma} + \frac{V_A^2}{2g} + Z_A = \frac{P_B}{\gamma} + \frac{V_B^2}{2g} + Z_B + h_L$
- Area = $0.03326\ \text{ft}^2$
- $V = \frac{Q}{A}$
- $f = \frac{2.5}{\left[\log\left(\frac{1}{3.7(D/\epsilon)} + \frac{5.74}{Re^{.9}}\right)\right]^2}$
- I.D = 2058 ft
- $k = \frac{8(L_i + L_e) f_i}{\pi^2 g D^5}$

Procedure:

1) Collected all data necessary to create an excel spreadsheet
2) Assumed 1 circuit
3) Guessed a flow rate for each pipe.
4) Did iterations on excel until 0% difference was acquired.

Problem 1 Test 3 Dezmond Banks

Circuit 1

	L(ft)	Le	D(ft)	e(ft)	e/D	Q initial (ft^3/s)
a-b	50	0	0.2058	1.50E-04	7.29E-04	
a-c	30	0	0.2058	1.50E-04	7.29E-04	
c-d	50	0	0.2058	1.50E-04	7.29E-04	
b-d	30	0	0.2058	1.50E-04	7.29E-04	

Trial 1
Circuit 1

	Q(ft^3/s)	Re	f	k	h=kQ^2	2kQ	deltaQ	%change
a-b	0.6	1.28E+05	0.037876	1.29E+02	4.65E+01	1.55E+02		75%
a-c	-0.6	1.28E+05	0.037876	7.75E+01	-2.79E+01	-9.30E+01		75%
c-d	-0.3	6.41E+04	0.037876	1.29E+02	-1.16E+01	-7.75E+01		150%
b-d	0.3	6.41E+04	0.037876	7.75E+01	6.97E+00	4.65E+01		150%
					1.39E+01	3.10E+01	4.50E-01	

Trial 2
Circuit 1

	Q(ft^3/s)	Re	f	k	h=kQ^2	2kQ	deltaQ	%change
a-b	-1.50E-01	3.21E+04	0.037876	1.29E+02	-2.91E+00	-3.87E+01		307%
a-c	1.05E+00	2.24E+05	0.037876	7.75E+01	8.54E+01	1.63E+02		44%
c-d	7.50E-01	1.60E+05	0.037876	1.29E+02	7.26E+01	1.94E+02		61%
b-d	1.50E-01	3.21E+04	0.037876	7.75E+01	1.74E+00	2.32E+01		307%
					1.57E+02	3.41E+02	4.60E-01	

Trial 2
Circuit 1

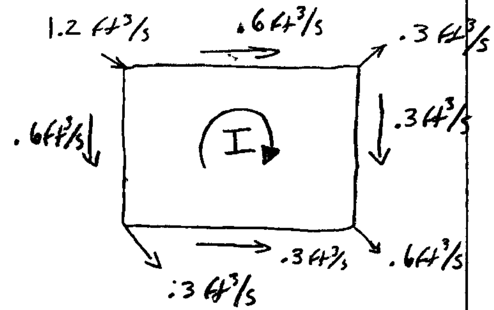
	Q(ft^3/s)	Re	f	k	h=kQ^2	2kQ	deltaQ	%change
a-b	6.10E-01	1.30E+05	0.037876	1.29E+02	4.81E+01	1.58E+02		74%
a-c	-5.90E-01	1.26E+05	0.037876	7.75E+01	-2.69E+01	-9.14E+01		76%
c-d	-2.90E-01	6.19E+04	0.037876	1.29E+02	-1.08E+01	-7.48E+01		155%
b-d	3.10E-01	6.63E+04	0.037876	7.75E+01	7.46E+00	4.81E+01		145%
					1.77E+01	3.94E+01	4.50E-01	

Trial 3
Circuit 1

	Q(ft^3/s)	Re	f	k	h=kQ^2	2kQ	deltaQ	%change
a-b	-1.60E-01	3.42E+04	0.037876	1.29E+02	-3.32E+00	-4.14E+01		287%
a-c	1.04E+00	2.22E+05	0.037876	7.75E+01	8.38E+01	1.61E+02		44%
c-d	7.40E-01	1.58E+05	0.037876	1.29E+02	7.07E+01	1.91E+02		62%
b-d	1.40E-01	2.99E+04	0.037876	7.75E+01	1.51E+00	2.17E+01		328%
					1.53E+02	3.32E+02	4.59E-01	

Problem 1 | Test 3 | Dezmond Banks

Calculations:



* Used excel to calculate iterations

Summary:

The purpose of this problem was to test the students knowledge on calculating the flow rate of a piping system. The problem required calculating flow rate of water in each pipe while neglecting minor losses.

Materials:

- Water
- 2 ½ Schedule 40 pipes
- Valve

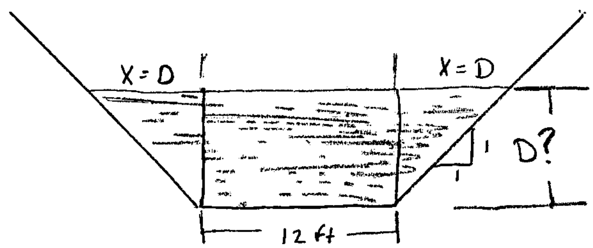
Analysis:

In this problem my biggest issue was getting my excel sheet to function correctly, which I was clearly unable to do. I assumed that since the valve was in the system, there would only be 1 circuit.

Problem 2	Test 3	Dezmond Banks

Purpose: Determine the water depth when flow rate is $34.7\ ft^3/s$

Drawings:



Sources:
- Mott & Untener. Applied Fluid Mechanics. 7th Edition. Pearson 2015
- Blackboard lectures & HW Solutions

Design Considerations:

- incompressible fluid
- Since slope is 1:1 ratio $X = D$
- Trapazoid channel

Data & Variables:

- "n" value $= 0.04$
- $Q = 34.7\ ft/s^2$
- $A = WD + XD$
- $R = \frac{A}{WP}$
- Slope $= .00015$
- $AR^{2/3} = \frac{nQ}{S^{1/2}}$
- $WP = W + 2L$
- $L = \sqrt{x^2 + D^2}$

Procedure:

1) Found $AR^{2/3}$
2) Set x equal to D
3) Used excel to calculate iterations
4) Assumed D
5) Changed D until my new $AR^{2/3}$ was equal to my caculated.

Problem 2 Test 3 Dezmond Banks

Y	A	WP	R	R^2/3	AR^2/3	New AR^2/3	AR^2/3
1	13	14.82843	0.876694	0.916007	113.329	11.9080924	113.329
3	45	20.48528	2.196699	1.689846	113.329	76.04305694	
4	64	23.31371	2.745166	1.960555	113.329	125.4755328	
3.5	54.25	21.89949	2.477226	1.830812	113.329	99.32155376	
3.8	60.04	22.74802	2.63935	1.909845	113.329	114.6670657	
3.7	58.09	22.46518	2.585779	1.883914	113.329	109.4365402	
3.75	59.0625	22.6066	2.612622	1.896929	113.329	112.0373568	
3.77	59.4529	22.66317	2.623327	1.902107	113.329	113.0857714	
3.774	59.53108	22.67448	2.625466	1.903141	113.329	113.2960092	
3.7745	59.54085	22.6759	2.625733	1.90327	113.329	113.322302	

Problem 2	Test 3	Dezmond Banks

Calculations:

$$AR^{2/3} = \frac{nQ}{S^{1/2}}$$

$$AR^{2/3} = \frac{(.04)(34.7)}{(.00015)^{1/2}}$$

$$AR^{2/3} = 113.329$$

$W = 12 \qquad X = D$

$A = WD + XD$

$A = 12D + D^2$

$WP = W + 2L \qquad L = \sqrt{D^2 + D^2}$

$L = \sqrt{2D^2}$

$WP = 12 + 2(\sqrt{2D^2})$

* Iterations on excel spreadsheet

$D = 3.7745$

Summary:

The purpose of this problem was to test the Students Knowledge in Computing depth of flow for open Channels.

Materials:

- Water

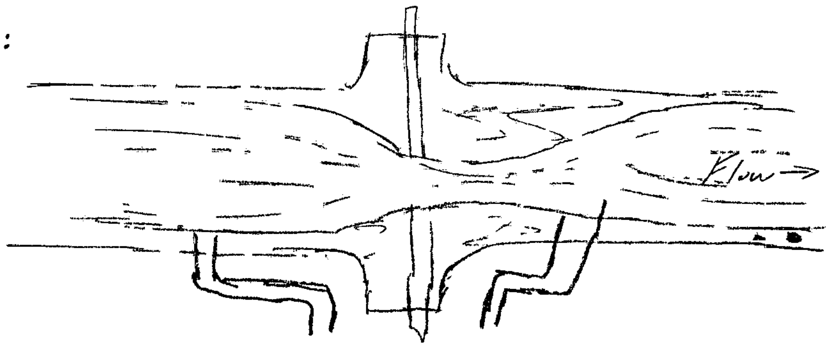
Analysis:

Through the use of excel I was able to make educated guesses on the depths of the trench until I found the desired depth.

Problem 3 | ~~Test~~ 3 | Dezmond Banks

Purpose: Determine appropriate manometer scale range to be used

Drawings:



Sources:
- Mott & Untener. Applied Fluid Mechanics 7th edition. Pearson 2015
- Blackboard lectures & HW Solutions

Design Considerations:
- Type K copper tube
- Manometer used for pressure measurement
- linseed fluid

Data & Variables:

3.741 in Flow nozzle   4 in Type K copper tube   Linseed oil @ 77°F

$Q = 700\,gpm$ to $100\,gpm$ merc manometer $\gamma_{oil} = 58\ lb/ft^3$

$ID = .3214\ ft$ $A = 8.114\mathrm{E}{-2}\ ft^2$ Viscosity $= 3.84\mathrm{E}{-4}\ ft^2/s$
3.857 in

$700\,gpm = 1.5591\ ft^3/s$

$1000\,gpm = 2.228\ ft^3/s$

Procedure:

1) Find all neccessary values / given data
2) Manipulate formula to solve for h

Problem 3 | Test 3 | Dezmond Banks

Calculations:

$$V_{min} = \frac{1.559\ ft^3/s}{8.114e^{-2}\ ft^2} \qquad V_{max} = \frac{2.228\ ft^3/s}{8.114e^{-2}\ ft^2}$$

$$V_{min} = 19.21\ ft/s \qquad V_{max} = 27.46\ ft/s$$

$$V_1 = C_1 \sqrt{\frac{2gh\left[(\gamma_m/\gamma_{oil})-1\right]}{(A_1/A_2)^2 - 1}}$$

Summary:

The purpose of this problem was to test the students knowledge on flow nozzles and manometer scale ranges. In this problem the student was required to determine the manometer scale range to be used.

Materials:

- Manometer
- Type K copper tubing
- Mercury
- nozzle
- linseed oil

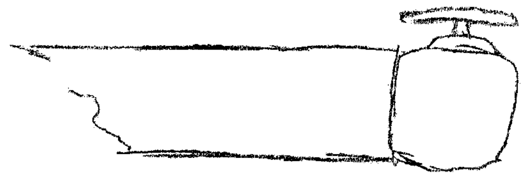
Analyzis:

The problem required the manipulation of formulas along with iterations from excel to find the approximate manometer scale.

Problem 4 | Test 3 | Dezmond Banks

Purpose: Determine minimum pipe thickness

Drawing:



Sources:
- Mott. & Untener Applied Fluid Mechanics 7th edition Pearson 2015
- Blackboard lectures & Solutions

Design Considerations:
- Steel pipe
- incompressible Fluid
- Pipe Failure?
- Valve closed

Data & Variables:

$\delta = 10mm$

$E = 2 \times 10^7 N/cm^2$

$E_0 = 2.03 \times 10^5 N/cm^2$

$ID = 600mm$

$V = 2.5m/s$

$P = 600 psi$

Procedure:

1) Use given values to calculate
2) plug calculated values into pipe thickness formula
3) Calculate pipe thickness.

Problem 4	Test 3	Dezmond Banks

Calculations:

$\epsilon = 2E7\ N/cm^2$

$V = 2.5 m/s$

$\epsilon = 2.03E5\ N/cm^2$

$\delta = 10mm$ $D = 600mm$

$$t = \frac{PD}{2(St + pY)}$$

$$t = \frac{(600psi)(}{2 \qquad + (600psi)(.40)}$$

Summary:

The purpose of this problem was to test the students knowledge on piping systems. Th problem required the student to calculate the required minimum thickness of the pipe to accomodate the design pessure of the system

Materials:

- Steel pipe
- Water
- value

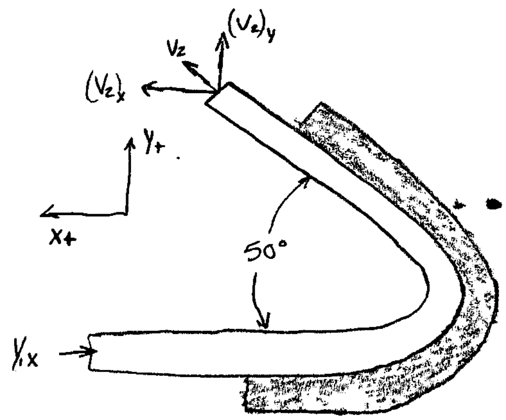
Analysis:

This problem required the use of the pipe thickness formula and possibly some iterations for h. Using the given values with some of the formulas from the book one should be able to solve this problem.

Problem 5 | Test 3 | Dezmond Banks

Purpose: Determine water velocity if $FH = 30.8$ lbf
Determine vertical force $(V_2)_y$

Drawing:



Sources:
- Mott & Untener. Applied Fluid Mechanics 7th edition. Pearson 2016
- Blackboard Lectures & HW solutions

Design Considerations:

- $(V_1)_y = 0$
- +y / +X
- incompressible fluid

Data & Variables

$F_x = \rho Q (V_{2x} - V_{1x})$ $\quad \rho = 1.88$ slugs/ft^3 $\quad T_{H_2O} = 180°F$

$F_y = \rho Q (V_{2y} - V_{1y})$ $\quad F_H = 30.8$ lbf $\quad A = 2.95 in^2 = 0.20 ft^2$

$Q = AV$ $\quad V_{2x} = V_1 \cos\theta$ $\quad V_{2y} = V_1 \sin\theta$ $\quad \theta = 50°$

Procedure:

1) Subbed $V_1 \cos\theta$ for V_{2x} in $F_x = \rho Q (V_{2x} - V_{1x})$
2) Solved for V_1 by isolating it to one side
3) Calculated V_2 using my new found V_1
3) Calculated the F_y using formula $F_y = \rho Q (V_{2y} - V_{1y})$

Problem 5 | Test 3 | Dezmond Banks

Calculations:

$$F_x = \rho Q\,(V_{2x} - V_{1x})$$

$$F_x = \rho A V\,(V_1 \cos 50 - V_{1x})$$

$$30.8 = (1.88)(.020)V_1\,(V_1(.643) - (-V_1))$$

$$30.8 = (1.88)(.020V_1)\,(.643V_1 - (-V_1))$$

$$(.0376V_1)(.643V_1 - (-V_1))$$

$$(.024V_1^2 + .0376V_1^2)$$

$$\frac{30.8}{.0616} = \frac{(.0616V^2)}{.0616}$$

$$500 = V^2$$

$$\sqrt{500} = V$$

$$22.36 = V_1$$

$$V_{2x} = 22.36(\cos(50))$$

$$V_{2x} = 14.37$$

$$V_{2y} = 22.36(\sin(50))$$

$$V_{2y} = 17.13$$

$$F_y = \rho Q\,(V_{2y} - V_{1y})$$

$$F_y = \rho A V\,(V_{2y} - V_{1y})$$

$$F_y = (1.88)(.447)(17.13 - 0)$$

$$F_y = 14.416 \text{ lbf}$$

Problem # 5	Test 3	Dezmond Banks

Summary:

The purpose of this problem was to test the students Knowledge on Calculating the effect of Vanes on Water streams. In this particular problem I had to Solve for velocity and force vertical without Knowing the flow rate of the water.

Materials:

- Vane
- Water

Analysis:

By manipulating the equation $F_x = \rho Q (V_{2x} - V_{1x})$ I was able to sub $V_{2x} = V_1 \cos\theta$ into the equation and solve for V_1. After finding V_1 I simply had to sub it back into the equation to find the force vertical.