Summer Research in the ME Thermal-Fluids Lab

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Objectives

- Run all equipment to check operational status
- Create database of accurate experimental data and results for use by new faculty
- Develop new experimental procedures for equipment not currently used

Accomplishments

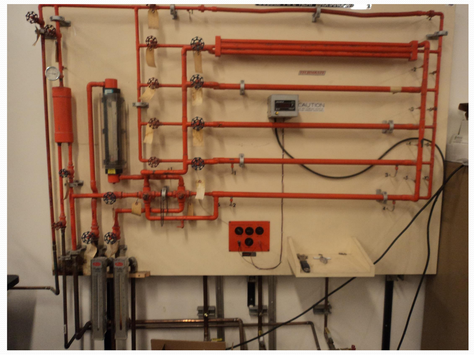
- Data was collected and analyzed for the following experimental equipment currently used by ME 491 students
  - Pressure Measurement
  - Air Flow Measurement
  - Water Flow Measurement
  - Shaft Power Measurement
  - Centrifugal Pump
  - Centrifugal Fan
  - Airfoil Lift and Drag Measurement
  - Refrigeration Cycle

Refrigeration Cycle

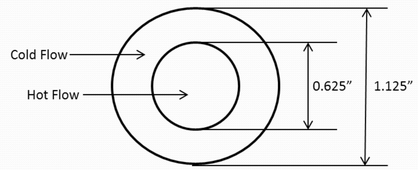
Centrifugal Pump

Centrifugal Fan

Heat Exchanger Experiment



- Heat exchanger experiment was run to determine obtainable results and develop new operational procedure for ME 491 lab manual
- Equipment allows simple shell and tube heat exchanger to be operated in parallel and counter flow modes
- Hot water flows in inner tube, cold water flows in annulus between inner tube and shell
- Overall heat transfer coefficient (U) for parallel and counter flow cases at different flow rates were determined experimentally and theoretically



Cross section of the heat exchanger

For Experimental U:

$$q = m_{dot} c \Delta T = U A_o \Delta T_{lm}$$

For Theoretical U:

$$U_o = \left(\frac{1}{h_o} + \frac{A_o}{A_i} \frac{1}{h_i} \right)^{-1}$$

Using h values determined from:

$$Nu_D = \frac{hD_h}{k} = \frac{\left(\frac{f}{8}\right)(Re_D - 1000)Pr}{1 + 12.7\left(\frac{f}{8}\right)^{0.5}(Pr^{\frac{2}{3}} - 1)}$$

Flow Rates		Parallel Flow			Counter Flow		
Q cold	Q hot	Experimental U	Theoretical U	Percent Diff.	Experimental U	Theoretical U	Percent Diff.
(gpm)	(gpm)	(W/m^2-K)	(W/m^2-K)	%	(W/m^2-K)	(W/m^2-K)	%
2	2	1759.20	1401.58	25.52	1611.03	1470.76	9.54
2	4	1989.10	1665.72	19.41	1982.00	1652.96	19.91
2	6	2157.63	1761.87	22.46	2111.10	1780.48	18.57
4	2	2403.95	2133.13	12.70	2237.61	2197.18	1.84
4	4	2998.22	2758.56	8.69	2935.03	2661.38	10.28
4	6	3288.58	3025.96	8.68	3066.36	3051.26	0.50
6	2	2638.54	2561.92	2.99	2570.56	2584.40	0.54
6	4	3411.92	3482.41	2.02	3389.26	3362.92	0.78
6	6	3834.74	3921.73	2.22	4075.62	3968.60	2.70

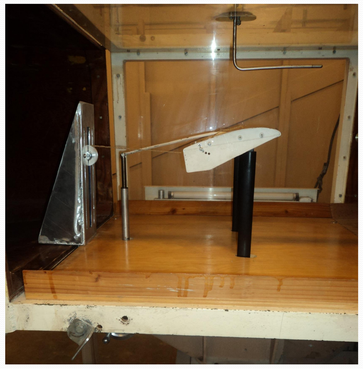
Results

Accomplishments cont.

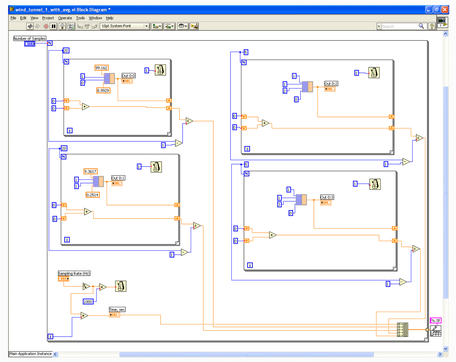
- "Rankine Cycler" steam plant was operated successfully, and preliminary data was collected and analyzed

Rankine Cycler

- Large subsonic wind tunnel force balance was calibrated and LabVIEW file for data display and average was developed.



Wind Tunnel Force Balance



LabVIEW File