PIPE LOSS EXPERIMENT REDESIGN PROJECT 10

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DESCRIPTION

Figure 1 – Dr. Ciocanel

- CLIENT: DR. CONSTANTINE CIOCANEL
- THE PROJECT TEAM IS TO EVALUATE, AND THEN REDESIGN THE PIPE FLOW TABLE EXPERIMENT CURRENTLY USED IN THE THERMAL SCIENCES LAB (ME-495).
- THE CURRENT SYSTEM IS OUTDATED AND DOES NOT FULFILL THE FUNCTIONALITY REQUIREMENTS THAT MAKES THE LAB AS EFFICIENT AS POSSIBLE FOR STUDENTS.

BACKGROUND

- THE CURRENT TABLE IS DESIGNED TO MEASURE DIFFERENT PRESSURES ALONG THE PIPES THROUGH VARIOUS JUNCTIONS AND LENGTHS.
- THE TABLE USES A PUMP, COPPER PIPING, THREE FORMS OF FLOW MEASUREMENT, AND A HANDHELD MANOMETER FOR THE EXPERIMENT.
- THE TABLE IS ABOUT 15 YEARS OLD

Figure 2 – Current Design

BACKGROUND & BENCHMARKING

- THE EXPERIMENT IS DONE TO SHOW STUDENTS HOW DIFFERENT PIPE FITTINGS AND DIAMETERS AFFECTS THE PRESSURE AND HEAD LOSS THROUGH THE FLOW.
- OTHER UNIVERSITIES AROUND THE NATION HAVE DESIGNED SIMILAR EXPERIMENTS THAT ARE MEANT TO ACHIEVE THE SAME LEARNING OUTCOMES.
- ME-495 UTILIZES THE SAME PROCESSES IN ANOTHER EXPERIMENT, BUT IN A MORE SIMPLISTIC DESIGN.

Figure 3 – Alternate Lab Design

CUSTOMER REQUIREMENTS

- THE TABLE WILL NEED TO ACCOMMODATE DIAMETERS RANGING FROM 0.5 INCHES TO 2 INCHES, AND A LENGTH OF AT LEAST 10 FEET AT ONE SECTION.
- T, ELBOW, AND STEP UP/DOWN JOINTS ARE NECESSARY FOR THE EXPERIMENT TO GET THE DESIRED RESULTS.
- THERE MUST BE RELIABLE PRESSURE MEASURING PORTS ALONG THE PIPES TO ALLOW FOR READINGS FROM A HAND-HELD MANOMETER.
- THERE WILL NEED TO BE THREE VOLUMETRIC FLOW RATE TRANSDUCERS, AS WELL AS A VALVE OR OTHER SYSTEM FOR ADJUSTMENT OF FLOW RATE.
- MUST SUPPORT A REYNOLDS NUMBER FROM 10^4 TO $3 * 10^5$.

ENGINEERING REQUIREMENTS

- FROM THE CUSTOMER REQUIREMENTS WE FORMULATED VARIOUS ENGINEERING REQUIREMENTS TO ENSURE THE FUNCTIONS OF THE EXPERIMENT ARE MET.
- THE HOUSE OF QUALITY SHOWS A DETAILED LAYOUT OF THE CUSTOMER AND ENGINEERING REQUIREMENTS, HOW THEY RELATE TO EACH OTHER, AND THEIR IMPORTANCE TO THE PROJECT.

Table 1 – Engineering Requirements

Engineering Requirements
120 RMS Voltage
Reynold Number Range of $10^4 \ - 3 * 10^5$
Set Pressure Range (TBD)
Minimal Diameter of $^1/_2$ inches
Total Minimal Head Loss (TBD)
Cost of Components

System QFD		Project:	Experimentail Pipe Flow Losses						
		Date:	2/1/18						
			Input areas are in yellow						
120 RMS									
Operates within Reynolds Range (10^4 - 3*10^5)									
Operates Within Set Pressure Range			9						
Smallest Diameter pipe is 1/2 in			6	6					
System has a measureable minimun head loss			9	9	9				
Cost		6	1	3	9	3			
			Technical Requirements						
Customer Needs	Customer Weights	120 RMS	Operates within Reynolds Range (10^4 - 3*10^5)	Operates Within Set Pressure Range	Smallest Diameter pipe is 1/2 in	System has a measureable minimun head loss	Cost		
Reliability	5	6	3	3	1		6		
Durability	4	3	6	6	1		6		
Last 10 years	2	1	1	3	1		9		
Variable Control	5	1	9	9		6	3		
One Contraction Joint	5		3	6	6	9	1		
One Expansion Joint	5		3	6	1	9	1		
One Elbow Joint	5		3	6	1	9	1		
One T Joint	5		3	6	1	9	1		
Two Volumetric Flow Rate Sensors	5		1	1			6		
Lab View Intergration	2					9	6		
Sensor Taps Placed in a spot for reliable readings	5		3	6	1	6	1		
Technical Requirement Units		Voltage (V)	Re	Pascal (Pa)	Inch (in)	Pascal (Pa)	Dollar ($)		
Technical Requirement Targets		120	10^4	5000	1	1000	3000		
Absolute Technical Importance		49	166	245	61	258	154		
Relative Technical Importance		5.25	17.8	26.3	6.54	27.7	16.5		

Figure 4 – System QFD

QFD ANALYSIS

- THE TOTAL HEAD LOSS WAS THE MOST IMPORTANT REQUIREMENT IN THE PROJECT.
- OPERATING BETWEEN A SPECIFIC PRESSURE RANGE WAS THE SECOND MOST IMPORTANT.

SCHEDULE

- THE SCHEDULE FOR OUR PROJECT WAS BROKEN DOWN BY OUR PROJECT MANAGER INTO A GANTT CHART FOR THE SEMESTER.
- AS A GROUP WE SELECTED OUR OWN ROLES, ORGANIZED OUR WORK AROUND WHAT OUR SCHEDULES ALLOWED AND WHAT OUR RESPONSIBILITIES WERE.
- WE ARE CURRENTLY ON SCHEDULE FOR THE SEMESTER AND HOPE TO REMAIN SO.

GANTT CHART

Name	Begin date	End date	Coordinator
Team Charter	1/18/18	1/25/18	All
Website Version 1	1/26/18	2/15/18	Keith
Website Version 2	2/16/18	3/29/18	Keith
Website Version 3	3/30/18	5/1/18	Keith
Presentation 1	1/26/18	2/8/18	All
Meet With Client	1/26/18	1/31/18	All
Project Description	2/1/18	2/7/18	Cole
Benchmarking	2/1/18	2/7/18	Mark
Gantt Chart Version 1	2/1/18	2/7/18	Michael
QFD Version 1	2/1/18	2/7/18	Keith
Budget Version 1	2/1/18	2/7/18	Mark
Peer Evaluation 1	2/8/18	2/8/18	All
Presentation 2	2/9/18	3/1/18	All
Conceptual Report	2/9/18	3/1/18	All
Functional Decomposition	2/9/18	2/12/18	All
Consider Designs	2/13/18	2/16/18	All
Select Design	2/16/18	2/24/18	All
Pugh Chart	2/16/18	2/19/18	Cole
Decision Matrix	2/19/18	2/24/18	Keith
Gantt Chart Version 2	2/16/18	2/24/18	Michael
Budget Version 2	2/16/18	2/24/18	Mark
Presentation 3	3/2/18	4/19/18	All
CAD Version 1	3/2/18	4/17/18	Michael
Bill of Materials Version 1	3/2/18	4/17/18	Cole
Design Requirements	3/2/18	4/17/18	Keith
Gantt Chart Version 3	3/2/18	4/17/18	Michael
Budget Version 3	3/2/18	4/17/18	Mark
Analysis Memo	3/2/18	3/15/18	All
Analytical Reports	3/16/18	4/5/18	All
Peer Evaluation 2	4/6/18	4/10/18	All
Final Report	4/6/18	4/26/18	All
Prototype Demonstration	4/20/18	5/3/18	All
CAD Version 2	4/20/18	5/1/18	Michael
Bill of Materials Verson 2	4/20/18	5/1/18	Cole
Peer Evaluation 3	5/3/18	5/3/18	All

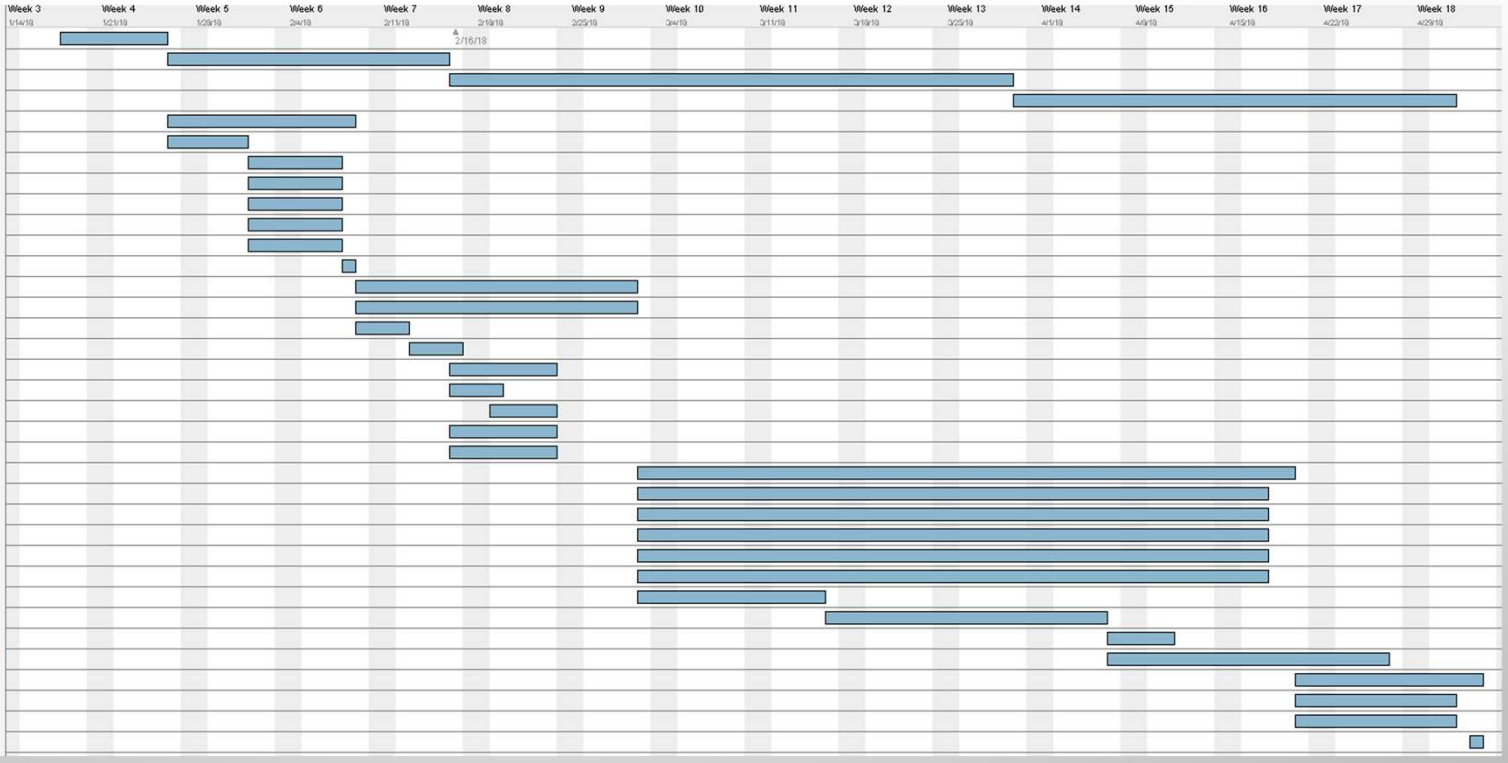

Figure 5 – Gantt Chart Schedule

BUDGET

- DR. CIOCANEL STATED A BUDGET FOR US AT AROUND $2,500 BASED ON CAPSTONE AND ME495 CLASS FEES.
- DR. CIOCANEL PROVIDED AN ESTIMATE OF THE CURRENT EXPERIMENT.
- WE ANTICIPATE THAT:
  - FITTINGS WILL COST $75
  - PIPING TO BE $125
  - PUMP TO BE $500
  - MOTOR TO BE $500
  - TABLE AND STRUCTURE TO BE $150
  - FLOW TRANSDUCERS TO BE $1000
- THIS BRINGS AN ESTIMATED TOTAL TO $2,350.
- NOTHING HAS BEEN SPENT TO DATE.

QUESTIONS?