Low Cost Real Life Laboratory for Mechanical Engineers

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ABSTRACT

With the current budget cuts that every university in the U.S. had to deal with, the priority of updating Under Graduate laboratories' equipment dropped few notches. At the same time it is still essential to provide engineering students with hands on experience in conducting, analyzing and reporting of experimental work. This extended abstract describes few experiments that were assigned in a laboratory course which required minimum equipment but still provided students with the needed experience.

1. INTRODUCTION

Under graduate laboratory for Mechanical Engineers attempts to cover variety of topics that are related to the different disciplines covered in the program, such as: Thermal Sciences, Mechanical Systems, Materials and others. In most places the laboratory is equipped with experimental setups and students are provided with well written manuals ("Cook Books") which are being used year after year. As a result, experiments become stale and students are loosing their interest in these activities. In this paper, a different approach was tried adopting the following requirements: all experiments have to be carried out in the field, experiments should present real life problems; experiments should be open ended; and simple, low cost instrumentation should be used. In the following three representing experiments will describe along with the tasks assigned for the students.

2. EXPERIMENTS DESCRIPTION

2.1.1 EXPERIMENT #1: THE WAITER PROBLEM

A customer places an order for a cup of coffee along with a dinner which he likes to drink at a certain time during the meal. He provides the waiter with the following information:

a) Proportion of the milk/coffee mixture (e.g. 1:3 means 3 parts of coffee and one part of milk).

b) Time at which he expects to drink the coffee.

c) Required coffee temperature at the drinking time.

At this point in time, the waiter pours the required portion of coffee and leaves the table. The coffee temperature versus time is shown in Figure 1.

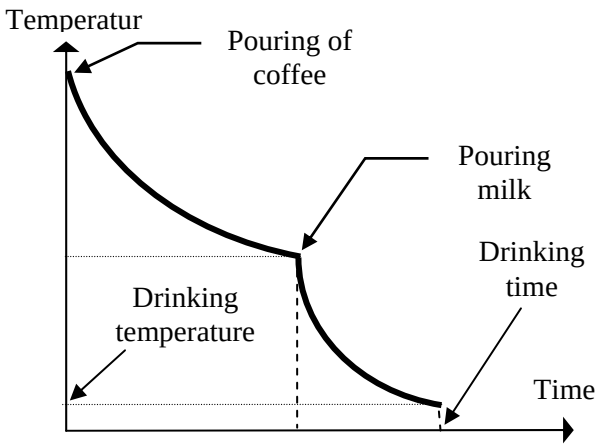

Figure 1: Coffee temperature versus time.

Assignments:

1. Design and perform any necessary number of experiments in order to develop a "tool" by which the waiter will be able to determine when to pour the milk so that the coffee will reach the required temperature at the right time.
2. Demonstrate your solution on at least two cases with different requirements than you used to develop the solution in (1).
3. Provide a full report.

2.1.2 EXPERIMENT #2: ROAD SPEED BUMP

A complaint was filed at one of south Florida courts against the city of Helem. The plaintiff, 30 year old 6'2" and weigh 210lbs, complained that as he was driving on city road, on January 2010 at about 3:00p.m., his car suddenly went over a bump and as a

result his head hit the vehicle's roof. He was driving approximately 25[mph] at 30[mph] zone. He admitted that there was a sign, about 20[ft] before the bump, warning drivers to reduce speed to 10[mph]. The plaintiff claimed that the sign was too close to the bump and he had no time to react. The plaintiff demanded $10,000 for medical, $20,000 lose of income, $30,000 for pain and suffering.

Assignment:

You were hired by the plaintiff (or defence) attorney to help in establishing the validity (or invalidity) of the claim. This is an open end problem but the minimum work you have to perform is given below:

1. Simulate the vehicle response as it travelling over the bump.
2. Drive the vehicle over the bump and take any necessay measurements.
3. Provide a full report covering yor testing, results and opinions.
4. Prepare a 5 minutes presntation you will be using in court to explain the jury your finding and opinions.

2.1.3 EXPERIMENT #3: TIE OUT STAKE TESTING

As a city engineer, located in a hurricane zone, you were approached by an inventor who proposes to cover mobile homes and recreational vehicles with a large plastic sheet just before the storm approaches. The plastic sheet will create a "dome" over these structures and as a result, the wind will flow over the "dome" with less resistance thus minimizing or eliminating possible damage. This sheet of plastic will be anchored to ground using tie out stakes. The city engineer decided to spend a little time and funds to check the feasibility of this idea.

Assignments:

Your part of this idea evaluation is to determine the loads these tie out stakes can provide for two different soils. An addition you should evaluate the effort required to install them. Design and perform any necessary number of experiments in order to:

1. Determine at high level of confidence (above 95%) what level of load these tie out stakes will support.
2. Determine the effort needed to install the tie out stakes and whether not an average person will be able to install them by himself.
3. Provide a full report.

3. COMMENTS

The above examples serve to demonstrate the concept discussed above. Some additional details might be helpful:

1. A pre-lab report was required before performing any testing. The report contained research on the subject, proposed testing methods and anticipated difficulties.
2. Minimum help was provided to students in order to force independent work and to simulate real working conditions where they might be on their own.
3. Equipment cost was kept to minimum: kitchen thermometer, cell pone accelerometer and a fishing scale which are commonly available.
4. The requirement for full report is essential for the future ability to communicate in the workplace.
5. At the end of experiment #2 a trial mockup was set up with jury members and a judge from the department staff. Students had to argue their case in front of the jury and answer questions posted by the judge. This oral presentation is also important for your future employment.

4. CONCLUSIONS

All in all, according to students' survey, their experience was positive. Although they were not used to such laboratory assignment, they grasp the idea very quickly and eventually enjoy they fact that they can come with there own solutions and methods to solve the problems. The draw back of this concept is that more sophisticated equipment, usually available in the laboratory cannot be used outside in the field and therefore students are not exposed to these devices. The solution is that a combination of both approaches is probably the best solution.

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