DEVELOPMENT OF PROJECTILE LAUNCHER FOR LEARNING PURPOSE

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A project report submitted in partial fulfilment of the requirements for the award of the Diploma of Mechanical Engineering

Faculty of Mechanical Engineering
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NOVEMBER 2007
Idea to design and fabricate a projectile motion is come from a supervisor that gives a task and a title for this project. To design and fabricate this projectile motion it must compare with the other product that available in laboratory. To make sure the idea to design and fabricate the projectile launcher that can be used for projectile experiment the information about current design for projectile motion must search or get from the internet. From there the information and idea to design and fabricate a projectile motion can be created. It includes many things about projectile motion design that wanted to gather accurate flight time data for projectiles. From there the efficiency of projectile motion analysis equation being determine. Whole of the project involve various methods like the concept design, the designing and also the fabrication process. After the assemble process complete the projectile launcher is tested to gather the flight time data for projectiles. Then the projectile motion analysis equation is solve from the time data. From the results the projectile launcher for projectile experiment was achieves the objective successfully. Overall in this project can bring a motivation and experience to conduct the various type of machine, train to work under the pressure, and also soft skill ability like time management, planning the task, negotiation skill and sell out the idea especially during work progress presentation.
ABSTRAK

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CHAPTER 1

INTRODUCTION

1.1 Introduction

The project involves designing and fabricating an instrument for projectile launcher experiment. This instrument could be used by the other student in order to test the projectile motion which according to the syllabus. As the Diploma final year project allocates the duration of one semester, this project only focused to provide the instrument for projectile in laboratory.

The project will be funded by student final year project funding, UMP short term project funding as well as sponsorship attained from industrial sponsors in terms of equipments, products and also monetary funding.

1.2 Project Synopsis

The project title is Development of Projectile Launcher for Learning Purpose. The project involves the launcher platform with different energy setting. Besides, the platform angle must be adjustable to get different launching angle with concerns
regarding strength, durability and the dynamics of structure. The fabrication is required to provide the instrument for projectile launcher. Modifications are required to improve appearance, comfortable and suitable with the student. The projects prerequisites are Dynamic and Strength of Material. Overall, also will acquire the skills of design, analysis, fabrication and testing.

1.3 Project Objective

1.3.1 General objective

Diploma final year project objective is to practice the knowledge and skill of the student that have been gathered before in solving problem using academic research, to born an engineer that have enough knowledge and skill.

This project important to train and increase the student capability to get know, research, data gathering, analysis making and then solve a problem by research or scientific research.

The project at another way will educate the student in communication like in a presentation and educate them to defend their research in the presentation.

The project also will generate students that have capability to make a good research report in thesis form or technical writing.

This project otherwise can produce and train student to capable of doing work with minimal supervisory and more independent in searching, detailing and expanding the knowledge and experiences.
1.3.2 Specific Project Objective

Basically this project is based on these objectives:

i. To design and fabricate a projectile launcher that can be used for projectile experiment.

ii. To gather accurate flight time data for projectiles.

iii. To determine the efficiency of projectile motion analysis equation.

1.4 Project Scope of Work

The project scope of work in this project is to develop a projectile motion for laboratory uses. Then, minimize the maximum and minimum angle of projectile. Beside that, manage the maximum and minimum energy setting for projectile.

1.5 Project Planning

This project is begun with made a research and search for information via internet, books, supervisor, and others relevant academic material that related to the title, this literature review takes about a week. The findings of information not stop there. It continues along the way of this project because knowledge is so many to learn.

At the same week have do schedule management for the project which included schedule management namely as Gantt chart (time management) and also flow chart (process management). This is done using Microsoft Office Excel using Gantt chart system.
The first week also had to arrangement several meeting with my supervisor to be clearly about the scope of title, synopsis from previous research and tool requirement.

The second week, have to submit the project title acceptance form and continue research in literature review of projectile and the instrument for the experiment, the information was are more details on projectile launcher experiment and the research of information, its takes more from previous research which similarity with my project title, this takes a week to be done.

The title are well clear at week third, it consist of scope and objective for the project. At this week, the meeting with supervisor only focused to choose the right design which is suitable for use in Universiti Malaysia Pahang (UMP) lab and also quite strength, durability, accurate and versatile for a learning purpose of projectile launcher.

At this week the sketch should finish with the right dimension and have to be approved by the supervisor. The engineering drawing was use Solidwork software to generate 3D model to design the model of project.

The sketching of the project takes about 2 weeks to be done. It complication because of what are the available material at the lab and another else the problem should consider what are the appropriate method to be machining. At the week fourth also should to find the material which right and suitable on design and machining. Actually the materials at the lab mostly under name by specific supervisor, for some of my project material are available at different supervisor it is need to discus with them whether allowed to take his material or not.

The week fifth is preparation of project progress, progress report writing and mid term presentation, these tasks take one week to be done. At this week the progress mid term presentation and progress report should be approved and submit to supervisor. At
the same way it should to prepare the speech for the presentation and double checked the report that has to be submitted. Also done on this week is discussion with the other supervisor to allow taking the material

The fabrication process is schedule to takes on the week sixth but because of several material arrival delayed the fabrication process has been postponed. On this week have to prepared more for mid-term presentation, it’s consist content, design and further information about the project.

Week seventh, this week are time for mid-term presentation. The main objective for that presentation it’s about to show to the panel how the far the work progress especially for individual project. In this week also it was started the fabrication, begun with cut the core material which used bend saw machine.

Next it's about further to the machining, milling, lathe, grinding, drilling, tapping, shearing and assembly. This task scheduled to take time about the rest of weeks. The model design for project around this time was change due to complication in machining, at first in follow the design, all the core material use several chunk bar mild steel due the complication in machining with milling machine to use bar shape and another to use rod shape.
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Figure 1.1: Gantt chart process planning

Planning Progress
Actual Progress
CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Firstly the concept from the research force, angle and gravity is a laboratory test used to find the incline free flight projectile motion and to determine law of gravity through experiment.

This project is provided the instrument for testing the projectile to which can explore of considered of great significance in improving the knowledge of time and how far ball fall being force- a condition that is prevalent in most laminated web or skin.

This chapter is summarizing of all the literature review gathered from many academic resources.

2.2 Paper Review

2.2.1 Pre review
The projectile launcher illustrates the idea that motion in different dimensions is absolutely independent. A good launcher not only illustrates this non-intuitive idea, but it can be used to describe the exact motion of the projectile as well. PASCO has precision-engineered projectile launchers that are accurate, durable and give repeatable results. In addition to the Short Range Launcher, a Long Range Launcher and a Mini (tabletop) Launcher are available. (ME-6800 Projectile Launcher (Short Range) - PASCO scientificp, http://www.pasco.com/)

The Projectile Launcher features have a flexible ranges which offers launchers for all classroom arrangements. That also Flexible Launch Positions, stable stand offers horizontal and variable angle launching positions. Also Fixed Firing Height at Any Launch Angle, able to firing height of the ball is the same for any launch angle. The Spring Mechanism ensure fully enclosed for safety. (G U NT Equipment for engineering education – EM 027, Projectile Launcher)

The features of the projectile is complicated to build, there is a need for a more comprehensive understanding of their behaviour in construction applications in order to provide some standardized design method. Research and construction projects are underway at the federal and state level, and at several universities. This project was partially conceived in support of that effort.

2.3 Formula

General formula which relate to this project:

Horizontal motion:

\[ v = v_0 + a_c t \]
\[ x = x_0 + v_0 t + \frac{1}{2} a_c t^2 \]
\[ v^2 = v_0^2 + 2 a_c (s - s_0) \]
For a projectile, there is no horizontal component of acceleration after the gun is fired. The only acceleration is due to the gravitational attraction of the earth (vertical). Hence, the equations above become:

\[ v_x = (v_0)_x \]
\[ x = x_0 + (v_0)_x t \]

**Vertical motion:**

\[ v = v_0 + a_y t \]
\[ y = y_0 + v_0 t + \frac{1}{2} a_y t^2 \]
\[ v^2 = v_0^2 + 2a_y (y - y_0) \]

Since the positive y axis is directed upward, then

\[ a_y = -g \]
\[ v_y = (v_0)_y - gt \]
\[ y = y_0 + (v_0)_y t - \frac{1}{2} gt^2 \]
\[ v_y^2 = (v_0)_y^2 - 2g(y - y_0) \]

Conservation of energy states that the total amount of energy in an isolated system remains constant, although it may change forms. In projectile launcher, energy from launcher spring is converted to kinetics and potential energy of the ball.

\[ E_{spring} = E_{kinetics} + E_{potential} \]
\[ E_{spring} = \frac{1}{2}mv_0^2 + mg\Delta h \]

Therefore,

\[ v_0 = \sqrt{\frac{2E_{spring}}{m} - 2g\Delta h} \]
2.4 Test procedure.

Do the following

Firstly, set the projectile launching angle at 30°. Secondly set the spring set at 1 joule energy. Then measure the height from the floor to projectile launching platform. Next, start launching and measure the distance of from projectile launcher to the point where the ball landing horizontally. As soon as the ball is launched, measure the flying time until the ball hit the ground. After that, repeat the experiment for three times and calculate the average of distance and flying time. Then repeat the procedure (1) until (5) by changing angle to 45° and 60° and fill in the table with the experimental and calculation result. Besides that, set spring energy to 1.5 joule and perform similar experiment starting with launching angle 30°. Lastly fill in table with result from energy setting 1.5 joule.

2.5 Experiment and component

i. Projectile launcher set
ii. Plastic ball with mass = 10 grams
iii. Measuring tape (10 meters)
iv. Stopwatch

2.6 Current Technology

➔ ME-6800 Projectile Launcher (Short Range)
Figure 2.1: ME-6800 projectile launcher (Short range)

This projectile launcher is lightweight. It also accurate, versatile, durable and easy to store. Beside that, it also easy to handling. This projectile common use in dynamic lab for experiment.

ME-6801 Projectile Launcher (Long Range)

Figure 2.2: ME-6801 Projectile Launcher (Long range)

Have a long range stand and it can be used to describe the exact motion of the projectile as well condition, stable and easily to handling.
This projectile is very stable because near with the ground. It capable to get the accurate result during the experimental. That uses the rubber to get free the force.

**Figure 2.3 : MVC-298F**

Use the current power supply and controller to setting the ball launching. This projectile is very accurate and suitable to use than other projectile because we must setting the angle first then the ball will launcher after push the button where connected with the electric.
Figure 2.4: P103 Projectiles
CHAPTER 3

METHODOLOGY

3.1 Project Flow diagram

From the diagram above, the project starts with literature review and research about the title. These tasks have been done through research on the internet, books and other sources.

After gathering all the relevant information, the project undergoes design process. In this step, from the knowledge gather from the review is use to make a sketch design that suitable for the project and applicable used in UMP lab. After several design sketched, design consideration have been made and one design have been chosen. The selected design sketched is the transfer to solid modelling and engineering drawing using Solidworks software.

After the engineering drawing finished – include detail design and approved by supervisor, the drawing was used as a reference for the next process which is fabrication process. This process is consists fabricate the parts that have design before by following the dimension using various type of manufacturing process. The manufacturing process included in the process is cutting, drilling, roughing, and finishing surface. For through all this fabrication process, it used varied machine such as bend saw machine, milling machine, lathe machine, shearing machine, grinding machine and drilling machine.
During the fabrication process, if there is something wrong occur such as not balance dimension so the process stop and go back to previous step, check the drawing back. For this project, the earlier design was changed when it go for fabrication process because the difficulty to fabricate using the available machine, the change of design around 60% from earlier design.

After the fabrication process, comes testing process. The testing is to gathered information about strength, durability, crash safety, design that has been fabricated. The test process just to testing whether the instrument are functioning or not. If this shear testing rig is working, its will go through the next process that is report process. And if the projectile is not working properly there should began again with the design process. Based on this project the testing process was success where this projectile available to give inclines free flight motion. The projectile occurs in some angle at testing ball.

After the process mentioned above is done. All the material for report writing is gathered. The report writing process will be guided by the UMP final year project report writing. This process also included the presentation slide making for the final presentation of the project.

The project ended after the submission of the report and the slide presentation has been present.
Figure 3.1: Project Flow Diagrams