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Programme: BEng Engineering Programmes

Module: Engineering Design

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Assignment title: Complied Group - Written Report

1.0 Introduction

This written report was made to look at the advantages and disadvantages of a trebuchet but focusing on the beam, counter weight and sling to increase the accuracy, distance of the payload. Also, will be looking at different designs and materials to insure optimum efficiency. The aim of this project is to make the best working launch and retrieve device with a 30 pounds budget.

2.0 Design

The design of group has decided to is a trebuchet. A trebuchet is a medieval weapon which is used to raid and destroy castles. the reason we have chosen this design is, that it can propel objects a far distance or a short by changing the counter weight, angle and payload. A trebuchet is a very well-balanced device with its planted legs. The disadvantage for using a basket as the counter weight is that the weight isn't fixed within the basket, they will slosh around can give inaccurate results or a misfire.

3.0 Materials

By doing research and to fit the groups budget of £30 they've decided to make trebuchet out of wood. There are many different materials that could have been used such as acrylic where it would fit the group's budget requirements however, the material is too light also too rigid and flexible when bent the wrong way. the group member who has designed the beam of the trebuchet thought of using a steel metal rod. The rod would be too heavy allowing a slow projectile launch for the payload. The designer of the beam has decided to make the beam out of wood. This will fit the budget requirements. Also allows the group to fillet the edges to increase strength and chamfer the edges and finish by sanding for a smooth balanced finish. To take the presentation of the design a step further the beam can be painted.

Sling

The sling which connects the payload to the beam will be made out of string the length is an important aspect to the trebuchet, the length the group will use 3.75 times longer than the counter weight arm, if the angle of the trebuchet is launched from is 45 degrees. This will allow the payload to launch in the right direction with optimum velocity. The reason the designer decided to use string instead of a more stretchable material such as a rubber, is that the results would be inaccurate and very difficult to calculate the efficiency of the trebuchet.

Counter weight

The basket its self will be made of simple plywood because its cheap easy to fabricate and will do all the things the group requires from the material. The weights used to put in the counter weight basket will be the 10g weights used in science experiments. The counter weight will not be fixed the beam nonetheless it will be free moving. This will allow better balance, smoother motion when launched and provide less chance of the weights to fall out.

4.0 Physics

The reason why the pivot point which is connected to the fulcrum, isn't in the centre of the beam because the squash ball will have a speed advantage. The counter weight side of the beam will have a smaller movement compared to the payload side. What differs from a catapult and a trebuchet? The catapult's payload is connected to the beam, where the trebuchet payload will hand from the beam by a sling. This will increase the speed advantage of the payload. To increase or decrease the distance of the squash ball is varied by many difference variables. To increase the group can increase the mass of the effort force or increase the height which the effort force is dropped from.

With a trebuchet we can calculate the efficiency by using trigonometry, and various different equations. First the group would calculate gravitational potential energy (E_{pg}) which is mass of the counter weight times gravity times height (mgh). Given that all the energy from E_{pg} has been turned into kinetic energy of projectile (E_{kp}). To find the velocity of which the payload will travel the equation one half mass of projectile times velocity squared. Once rearrange for velocity and square rooted the result the group will receive the result for initial velocity.

By gathering information and the motion of the trebuchet is that of a right-angle triangle. The hypotenuse is equal to initial velocity. The velocity traveling along the opposite of the angle is traveling vertically is equal to the velocity traveling along the adjacent therefore traveling in horizontally direction. Considering the angle of the initial velocity is 45 degrees. By using the change in velocity of the different directions and acceleration we can calculate the time. By calculate time the group can then calculate the distance. because distance is equal to velocity times time. Therefore, we can calculate our efficiency which is groups actual result divided by the groups theoretical distance therefore gives the efficiency of the trebuchet

5.0 Further workings

A whipper trebuchet is a slightly different design where the launch position is different the longer arm has almost rotated another 180 degrees. this will raise the counter weight above the main axle thus increasing the gravitational potential energy. However, the disadvantage of a whipper trebuchet is that it's difficult to find the right ratio for the arm, which will affect the direction of the payload.



(Oaklandballistics.com, 2020)

6.0References

https://moodle.uwtsd.ac.uk/pluginfile.php/334132/mod_resource/content/1/M4X01160_Sem2_Coursework2_2019-20.pdf [Accessed 1 Feb. 2020].

Moodle.uwtsd.ac.uk. (2020). *UWTSd Moodle 2019/20: Log in to the site*. [online] Available at: https://moodle.uwtsd.ac.uk/pluginfile.php/321420/mod_resource/content/0/2020%20Branded%20IMEchE%201st%20Year%20Spec%20Design%20Challenge%20-%20Project%20Specification%202020%20-%20V1.1.pdf [Accessed 1 Feb. 2020].