Project: Model Crane Pulley System	Client:	5mm Dot Grid Scale: 1:1
Designer:	Builder:	

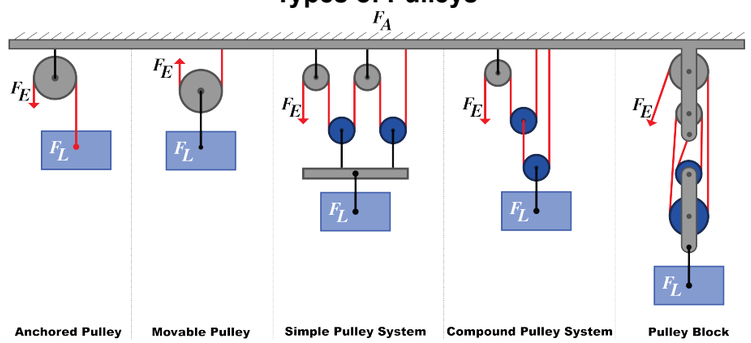
Model Crane Pulley System Design Challenge

Name: _____ Date: _____

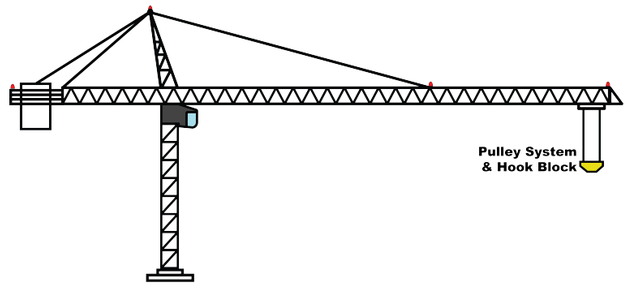
Introduction

Pulley systems can create a significant mechanical advantage. This means that the amount of work (which is indicated as F_E - Force Effort) can be significantly reduced. As a result, heavy objects or loads can be easily lifted with very little effort.

Types of Pulleys



Pulleys can be used by themselves, or they can be combined to create a simple or complex pulley system. A single pulley can be either anchored or movable. While an anchored pulley will change the direction of F_E, a moveable pulley will cut F_E in half but the direction of the applied force will not change. The advantage of simple and compound pulley systems is that a significant mechanical advantage (M_A) can be achieved. Finally, the design of pulley blocks allow engineers to create smaller more effective pulley systems for use in a variety of real world applications.



There are many real wold applications for pulley systems. Elevators, exercise machines, and toys are just a few examples of how pulleys get used. Tower cranes also use pulley systems which are attached to a hook block to lift heavy loads. By using custom pulley systems the Mechanical Advantage (M_A) of a tower crane can allow crane operators to lift heavy loads that typically weigh thousands of kilograms.

Design Challenge

In order for you to complete your crane design challenge you will need to deign all of the necessary mechanical systems that are needed to make your crane work. This will include building the hook block, pulley system, and a winch.

Winch: Noun /wɪntʃ/
A hauling or lifting device consisting of a rope or chain winding round a horizontal rotating drum, turned typically by a crank or by motor.

For this stage of the design challenge you only need to focus on creating the hook block and pulley system. The motor assembly and winch can be designed separately at a later time.

Design Considerations

There are two main methods that you can use when creating the mechanical systems for your model crane:

1. ***Use wood to create the hock block and then use store bought pulley wheels to create the pulley system;***
2. ***Or create and print a custom 3D hock block and pulley system.***

You could even use a combination of wood, store bought parts, and custom 3D printed parts when designing you hock block and pulley system.

Remember that your pulley system <u>needs to create a mechanical advantage</u> that will make lifting a load easier; however, it also needs to be simple enough that you can build it. You will need to find a balance when designing your pulley system. It needs to be <u>complicated enough to provide a mechanical advantage</u>, but also <u>simple enough that you can build it</u>.

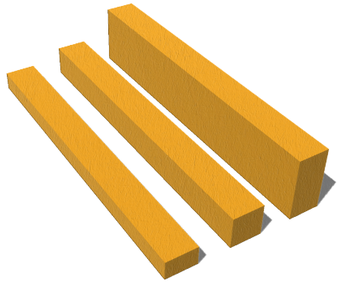
Finally, Your pulley system MUST work in a practical setting.

Instructions

Review the size of the available materials that you can use to build your hook block and pulley system. A list of the store bought materials and all relevant specifications have been listed on the next page. Then determine how you will go about designing a hook block and pulley system for your crane. Once you have a design strategy in mind you can start creating a design schematic using the provided template. Make sure that you <u>*use a ruler and include as many measurements as possible.*</u>

Materials Available

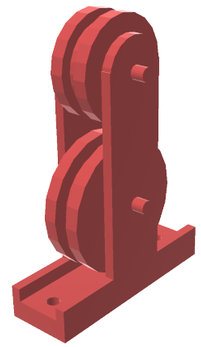
A list of all of the store bought materials that you can use to create your pulley block and pulley system and all relevant specifications have been provided below.



Lumber Specifications:
- 5.0 x 3.0 mm
- 5.0 x 5.0 mm
- 5.0 x 10 mm

Standard Pulley Wheel Specifications:
- 36.0 mm Diameter
- 4.0 mm Thickness (wheel)
- 6.5 mm Total Thickness
- 2.0 mm Grove
- 2.0 mm Shaft

You can design your hook block and pulley system using these standard materials, or you can design a custom pulley block and print it using a 3D printer. The advantage of creating custom parts is that you can create an advanced pulley block design that can benefit from varying sizes of pulley wheels. A sample of a custom pulley block which can be printed using a 3D printer has been provided for reference.



3D Printed Pulley Block Sample

Keep in mind that if you make custom pulley wheels, they should have similar attributes to the standard store bought pulley wheels. For example the thickness of the pulley wheel should be 4.0mm, the grove should be 2.0mm, and the central shaft should also be 2.0mm; however, the diameter of the pulley wheel and any other design choices are entirely up to you.