Moments and Fulcrums

An educational activity for children

Proposed by

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Introduction

The problem, as presented to us, was to design an activity the demonstrates a basic physics or engineering concept to younger students. The purpose of the exercise we designed is to acquaint children with the concepts of moments and fulcrums through experimentation with oddly-shaped balance beams. We will produce an "Activity Box" containing ten fulcrums and ten balance beams, along with a set of various weights. The activity, briefly, will involve the students balancing the beams using the weights.

Problem Statement

Sixth grade students do not generally understand the physical principle of moments. After an introduction to moments, these students can have a better understanding of the forces that engineers must consider when they design structures. For instance, sixth grade students may think that structures such as bridges must simply be able to hold a certain amount of weight. However, the placement of this weight is just as important as the quantity of the weight a structure can hold.

Objective

This activity introduces sixth grade students to the physical concept of moments. By balancing an irregularly shaped balance beam they can see how engineers must analyze the location of forces on a structure as well as the magnitude of these forces to ensure that the structure is stable. In real life, engineers must make calculations to reach these conclusions, but in this activity the students get to conduct a hands-on analysis.

Solution

The students can imagine that each beam is a winding road that connects two mountain sides. The road is supported by a bridge between the mountains. Unfortunately this bridge has been harmed in a severe storm so that it only has one remaining support (the fulcrum) instead of the network of structural supports that a

bridge should have. There are cars (the weights) which are stuck on the bridge and are in need of help. No one can get on the bridge to help the people in the cars because the bridge is tipped to one side. The students need to act as the structural engineers who decide where in relation to that one support each car should locate itself to balance the bridge. Once the bridge is balanced, the construction engineers can reattach the bridge to the road on each mountain side and allow the people to drive their cars to safety. Once again, engineers save the day.

Presenter material

The person serving as the presenter will give a brief demonstration of the process to the class. The presenter will use a conventional balance beam rather than the curved beams that the children will be using. The purpose of the demonstration is to familiarize the students with the concepts of leverage and fulcrums. Thus, a short description of these ideas will be written; as the presenter will either be a teacher or a visiting professor, we will assume he or she has a basic understanding of these concepts.

Student handouts

No handouts for the children will be necessary.

Building Materials

Cardboard
Heavy colored construction paper
22 heavy duty nails
Glue
Paint
Electric tape
Wood

What Needs To Be Built?

10 Irregular Balance Beams

- We will construct ten unique balance beams out of cardboard. These will be about 1.5 feet long and 3 inches wide. We will careful cut the desired shape for the beam out of a sheet of cardboard with a sharp knife. Each beam will have multiple layers

of cardboard to provide the desired level of toughness. At some place toward the center of each beam, we will insert one nail into each side of the beam to provide an axis for the beam to pivot around. (See Picture #1 in Appendix)

- Each beam will be covered with colored poster board and edged with colored electrical tape. The lengths of the beam segments will be labeled.

1 standard linear balance beam

- We will construct this beam just like the others. It will be used in a demonstration before the students begin their activity.

11 fulcrums

- These will be manufactured through LaserCamm. We will design each fulcrum in two flat pieces in AutoCAD. (See Picture #2 in Appendix) After the pieces are manufactured, we will assemble each fulcrum by hand. Each fulcrum will be identical and will be able to support any of the 11 balance beams. The fulcrums will be about 7 inches high with a weighted wood base to prevent it from tipping.

What Must Be Purchased

Fresh razor blades to cut the cardboard cleanly
A standardized set of weights
A box to carry the activity
Building Materials

Rapid Prototyping Process

LaserCamm

Plan and Schedule

We plan to have all of our beams constructed and all of our purchases completed by 15 April, giving us time to make final modifications to our Project Box before Carnival. The fulcrums will arrive to us in several pieces; the bases will need to be

weighted, and the fulcrums will need to be glued together. This process should not take long, but will be dependent on when we receive the parts from the rapid prototyping facility.

The beams will be manufactured according to the following process: Matt Vojik will perform the initial construction, and finishing will be done by Jen Supancic and Matthew Cain. Construction is currently underway and will be complete by 15 April.

Budget

For this project were given a budget of $100 to purchase the necessary supplies. In addition we have many items already in possession that will not need to be purchased.

Items	**Quantity**	**Costs**
Cardboard	2 sheets	$2.70
Colored Construction Paper	2 sheets	$4.00
Glue	1 bottle	$1.15
Items	**Quantity**	**Costs**
Electrical Tape	1 roll	$3.29
Exacto Blades	20 blades	$7.00
Exacto Knife	1 knife	0.00
Wood (2”x 6”)	10	0.00 (donated)
Paint	1 can	$3.00
Rapid Prototype Parts	20	0.00
**Weights	2 sets	$52.00
Carrying box	1 box	$10.00
Nails	22	0.00 (on site)
		Total: $ 83.14

** Weights we are still in the process of pricing the weights. The price given is the lowest we found.

Appendix

Picture #1 Original Idea Sketch
Picture #2 Prototype
Picture #3 Auto-Cad for Rapid Prototype Part