CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
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Project Number
J1812

Project Title
How Does Center of Gravity Affect Crane Design?

Abstract

Objectives/Goals
The engineering goal was to use center of gravity concepts to design a crane model that could support a given load at the maximum distance from the base.

Methods/Materials
Simple models of a boom crane and a tower crane were constructed from soda bottles and plastic rulers. Calculations were made for the counterweight required to resist an applied load at a given distance. Separately, a series of simple experiments were done using a plumb bob to find the center of gravity of various shapes. A z-shaped, two-dimensional, cardboard model crane was constructed using a movable counterbalance load to resist a weight at multiple distances along the arm. Three separate criteria were evaluated: the distance between the applied and the base, the distance of the counterweight relative to the base, and the angle of the boom arm. Using a plumb bob, the distance was measure at which the center of gravity moved beyond the support base and the model became unstable.

Results
Moving the counterweight farther from the centerline of the base did increase the maximum distance the applied load could be located from the base. However, the model experienced rear tipping due to the extended counterweight when the applied load was not fully extended.

Conclusions/Discussion
In conclusion, while the distance of the counterweight from the center of the base did improve the efficiency of the model, the most significant factor to maintaining stability was the weight of the base.

Summary Statement
The project investigates how center of gravity and balance concepts apply to the design of construction cranes.

Help Received
Mother helped cut materials for models, and also provided assistance for experiments that required more than one person.