CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)

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Project Number

31447

Project Title

Can I Engineer a Cheap, Easy to Build Hydro-power Crane?

Abstract

Objectives/Goals

I wanted to see if there was a cheap and efficient way for farmers and workers in poor countries to lift loads utilizing water power. I observed that workers in non-industrialized countries often use manual labor to lift heavy loads. Goal: To build a scale water crane which can lift an equivalent of 200 lbs.
Criteria: The crane needed to be low cost, use common easily obtainable materials and be easy to construct.
Constraints: The crane is only operational when it has access to a continuous flow of water. It has both a limited load capacity and mobility.

Methods/Materials

Methods: I built a prototype based the Greco-Roman Trispastos, 3-pulley crane design. I used a 3-gallon bucket as a reservoir and attached a paddle wheel to the crane axil to provide twisting power for lifting.

Results

Initial trials revealed that the initial design would not work because the threaded rod I used for the axle moved to the left because of the spiral threads. So I added two bolts and a washer to keep the rod from moving. I also noticed that there was a lot of friction where the axle rubbed in the brackets so I sprayed the axle with lubricant. The starting water pressure (head pressure) was also too low so I had to move the bucket up higher. The flat paddles I used for the water wheel also seemed to be not working so I replaced them with plastic spoons. This seemed to capture more of the waters force rather than just letting it just spray to the side. After the first trial the load would drop as soon as I turned off the water valve so I had to make a ratchet device. The rope I used at first was too stiff and was causing friction so changed this to 1/16# nylon twine.
I was able to get the model to work but it did not meet the lifting criteria. I only lifted 0.18 lbs. I think the model is too fragile to lift the target load of 20 lbs.

Conclusions/Discussion

I did not meet my engineering goal but I was able to create a functional crane and learned what I can do next time to make a more function model. I would first make the model a ¼ inch scale and then I would increase the size of the water wheel to increase the leverage and I would also use a greater mechanical advantage such as 4 to 1 pulley system so that I did not have to use as high a head pressure.

Summary Statement

Can I design a low cost easy to build water powered crane for lifting loads?

Help Received

Dad helped in building prototype, troubleshooting, and constructing display board.

Preliminary