

The Society of Physics Students at the University of Central Florida
Department of Physics
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Sigma Pi Sigma Undergraduate Research Award Recipient

The Ascending Double Cone: Verifying and Demonstrating the Motion Cone V-rail System

Final Report

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December 2006

Abstract:

The objective of this research project was to construct and investigate the physical properties of a common physics demonstration. We then compared the results to the theoretically based predictions made by one of our students, Sohng Gandhi. We planned to construct several variations on the demonstration and implement them into the physics I courses in our department. We are still in the process of evaluating all predictions and multiplying and distributing working models of this demonstration. We now have several new building tools and plan to encourage the building of different demonstrations to promote more activity within our department.

Experimental Procedure and Set-up

With a new wood lathe purchased, we turned blocks of wood into the symmetric double cones. Because full blocks of wood the size we wanted are difficult to find and expensive, we purchased long flat pieces and glued them together. David Bradford, a senior technician in the physics department, suggested using this method.

Before starting to lathe, we purchased all of the wood, tools, and safety equipment at a local Woodcraft store. This store also offers several woodturning classes which two of our students attended. After learning some important basics, these students were able to share what they had learned with the others.

In addition to our friends at Woodcraft, the above mentioned David Bradford, helped us greatly with a lecture on the lathe, wood, and safety. He also gave us several tips we found very useful. He also assisted in the purchase of the right materials at Woodcraft.

Our next step, with all the materials, was to make the double cones. We started with some scrap and lower quality wood to learn the technique of constructing the specific shapes we needed. With this technique down, we built two higher quality models with higher quality wood.

The process for the cones were as follows:



Left: a piece is loaded into lathe after being glued together.

First, we cut smaller identical pieces of wood. Most of the pieces were 5in x 1in x 8ft, and we cut them down to between 12in to 16in in length. We then stacked these pieces

Right: hourglass is sanded and ready to be cut from the pieces of wood holding it in place.

so that the cross section was a square of 5in by 5in. We glued the pieces together like this with strong wood glue. This process would take 4-5 hours including the time for the glue to dry. After the glue was dry, we would load the piece into the lathe and cut it down from a block to a cylinder of radius 5in.



Next made the shape of the double cone. There are several methods for this. Because the carpenter's wood working lathe is not made to be as accurate as some of the other metal working machines in the shop, we had use a keen eye and make a template. One method was to simply cut the double cone as one shape. This way we were able to get both sides down to the cone shape, but not to a point. This required extra work, as the pieces are held on the lathe between two end points, which had to be strong. We would have to sever one connection to make a point on one side, then take it off of the lathe and carve the other point by hand. This process is only required for the standard double cone shape.

Another method is to cut two separate single cones and glue them together at the bases. This enables us the get the full shape very easily, but it can be more difficult to make sure that the two single cones are exactly symmetric.

We were able to make both methods work, and certain other shapes could be cut fully and directly from the lathe. For every variation of cone, we needed a template to be sure of straight lines.



Left: Kevin Thomas checks one of the cones for smoothness after spraying



Right: Double cone inverted into the shape of an hourglass.

With the final shape, we sanded the piece smooth and sprayed it with a wood finish. We then constructed the V-rail for the cones. Because we needed cones of varying sizes and shapes, we required one rail that could change the angle at the vertex and the angle of incline. We currently have a V-rail made of plastic, with a hinge at the vertex enabling the vertex angle to change,

Right: Jonathon Fraine fuses a plastic bar to the rail to hold it in place.



but the next step is to control the incline exactly as we want it.

Conclusions

So far, the observations we have made have agreed with our predictions.



Above: Regular double cone and hourglass.

The two best models made are the original double cone shape, and the double cone inverted into the shape of an hourglass. The hourglass rolls up the rail very nicely, only we have already experienced that because the weight is outside of the rail, it bends the plastic rail inwards and changes the orientation of the rail at that position. This can simply be fixed with a stronger rail.

Our final V-rail system will be made out of metal so as to hold the weight of each cone. Because of the different woods used, some cones are heavier than others. The shapes of the cones also vary which vary the distribution of weight. Our final V-rail model will have to account for all of this.

Over all, we have realized that we underestimated the time we would need to complete this project. We have sent in another proposal requesting an extension for more time and money. We plan next semester to finish testing the predictions made by Sohang Gandhi and Costas Effthimiou. We also intend to implement this demonstration into our physics 1 course, as it illustrates the concept of center of mass, as well as several other key concepts of physics. This demonstration could help many students understand these concepts more effectively.

Accounting of Funds

The original funds requested were used for the materials needed to make the cones. Included were the



Above: A wood finish on the final pieces to protect them.

lathe and lathe tools, safety equipment for the hands and face, the wood for the cones and metal for the rails. We also used the money for two lathe lessons from Woodcraft. These lessons came in very handy and we are going to try and send a few more students to these classes. We have also applied for more money for these classes, as well as more building materials.