CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Eris D. Albert-Minckler

Project Number

J0301

Project Title

How Do Structures of Rigid Eggshells Affect Their Strengths and How Can This Be Used in Designing Temporary Shelters?

Abstract

Objectives/Goals

The purpose of my project is not only to test the strength of different rigid eggshells, but also to try to create an affordable, easy to construct, and overall better temporary home.

Methods/Materials

Three different types of eggs, emu, chicken, and quail, were tested to determine their strength against impacts of varying mass and height. Through equalizing equations and ratios the eggshell shown to be the most resilient was used as the bases for my shelter.

Results

After equalizing my data I found that the emu egg was the strongest of the three eggs. However, I chose to use the quail egg in designing my structure because it possessed more favorable attributes and was the most resilient. The quail egg when hit with a weight it couldn't withstand caved in, but was still serviceable unlike the emu egg which shattered at failure.

Conclusions/Discussion

I concluded that strength isn't the only indicator of something's durability, it is one of many. I decided to go with the quail egg because it was not only strong, but also flexible and light weight.

Summary Statement

My project focuses on using rigid eggshells as a model for creating improved temporary shelters.

Help Received

My mother was an invaluble resource of knowledge; Father helped with using excel and understanding needed equations.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Christian Arnold; Carson Coppinger

Project Number
J0302

Project Title
How Does Temperature Affect How Far a Baseball Travels?

Abstract

Objectives/Goals
The objective of our experiment was to see if the temperature of a baseball affects the distance it travels when bounced off a wall.

Methods/Materials
1. 30 baseballs , 2. Pitching machine, 3. Oven, 4. Freezer, 5. Measuring tape, 6. Wooden Wall.

We began by setting up a pitching machine fifteen feet away from a wooden wall. Then we took 10 heated, 10 cooled, and 10 room temperature baseballs and shot them at the wall one at a time. Then we measured the distance each ball bounced back and recorded it. We repeated this process again for each group.

Results
Data Summary
The baseballs that were heated bounced off the wall at an average distance of 69.9 centimeters.The baseballs that were room temperature bounced off the wall at an average of 51.8 centimeters. The baseballs that were cooled bounced off the wall at an average of 39.5 centimeters.Our results showed that the warm baseballs went farther than the cold baseballs by an average length of 30.4 cm.

Conclusions/Discussion
Conclusions and Discussion
Our hypothesis appears correct. The baseballs that were heated up bounced further off the wall than the room temperature and cooled baseballs. The baseballs that were left at room temperature bounced further off the wall than the cooled baseballs but not as far as the heated ones. The baseballs that were cooled down didn#t bounce as far as the room temperature baseballs or the heated ones. We think this happened because when the balls are heated up the molecules have more energy, so they move around faster, increasing movement. When the leather cover and insides are heated up, the ball is more elastic and has more #give.# When baseballs are cooled down, they are harder which causes them to #thud# off the wall. Our experiment is important because baseball players(using wood bats) could possibly hit the ball farther or shorter in different temperatures. Baseball players(using wood bats) could possibly hit the ball farther in hot weather and shorter in cold weather. For example someone who plays in Palm Springs could have better hitting stats than someone who plays in Denver.

Summary Statement
Our project is about how temperature affects how far a baseball travels.

Help Received
Dad helped heat and cool the baseballs

Name(s)

Bryan A. Cuevas

Project Number

J0303

Project Title

Building Shock Absorbers for a Bicycle

Abstract

Objectives/Goals

The goal of my project is to create a shock absorber that will be cheaper and as efficient as a store-brand shock absorber.

Methods/Materials

An acrylic sheet, two acrylic tubes, two springs, a solvent, and a power tool are needed to create the shock absorber. You must cut three circles for the ends of the tubes to help with stability. One of the circular coverings should be small enough to fit inside the interior tube. One of the other coverings should be small enough to fit tightly within the exterior tube. The last covering should cover a bit over the edge of the interior tubes outside end. Then you drill a hole into each of the three circles, so this may increase air pressure. Then you would attach the springs to the end of the interior tube that would fit inside of the exterior tube.

Results

My shock absorber handled a good amount of weight and was cheap to build. It is also as durable as a store-brand shock absorber.

Conclusions/Discussion

My conclusion is that I fulfilled my goal, and that acrylic could be used instead of metals, like aluminum, because it is light, cheap, and durable to use.

Summary Statement

I am creating a shock absorber that will be cheaper and as efficient as a store-brand shock absorber.

Help Received

My teacher, Mr. Robison, helped me obtain certain items, and Good Karma Bikes gave me the bike parts for my project.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Amy F. Domae

Project Number
J0304

Project Title
Designing Stronger Lightweight Support Columns

Abstract

Objectives/Goals
The choice of regular polygon shape for the perimeter of a short hollow structural support column can increase a column's compression strength by several times. The objective is to determine why shape causes a significant difference in strength so that stronger lightweight support columns can be made.

Methods/Materials
Method: (1) Make 10 columns for each regular polygon- PART 1 (constant perimeter): triangle, square, pentagon, hexagon, octagon, 16-gon, 20-gon, circle; PART 2 (constant area): square, hexagon, octagon, circle; PART 3: constant perimeter rectangles of 4 different sizes including square. (2) Place flat cardboard and container on top of each column. (3) Add incremental weights until column collapse. Video, photo, observe changes. (6) Measure total weight on the column at collapse. (7) Calculate average collapse weight for each set of trials; analyze.
Materials: 110 lb. cardstock, hot glue sticks, hot glue gun, cardboard, paper cutter, weights-penny rolls, digital postal scale

Results
PARTS 1 and 2: A short hollow column shaped as a regular polygon has increasing compression strength as the number of polygon sides is increased, and this relationship holds even when decreasing the amount of material to make shapes of identical area. In Part 1, circles had 4.7 times the compression strength of triangles. PART 3: Corners fail first and rectangles that better fit the size and shape of the load are stronger.

Conclusions/Discussion
My results show that compression strength is determined by a column's ability to balance its load. A column collapses when its weakest parts - faces or vertices - begin to fail and the column cannot maintain balance. Stronger shapes have more faces/vertices to share the load after weak parts buckle. Circles, with an infinite number of sides, are strongest. Hexagons are often used for high compression strength lightweight columns, but circular columns could be lighter and stronger with less material.

Summary Statement
My project shows that significantly different compression strengths result from different regular polygon shapes and analyzes why this happens.

Help Received
My mom took photos and videos of the experiments and helped to edit the report. Science teacher, Mr. Briner, reviewed project progress.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Jessica Fairlie; Makena Keane

Project Number

J0305

Project Title

Tsunamis and Stilts

Abstract

Objectives/Goals

Tsunamis are one of the fiercest natural catastrophes that can happen. In poor countries people make houses out of whatever materials they can find. Houses are often built out of cardboard, thin wood, and corrugated tin. Although the materials they use to build houses can#t be replaced because of the cost, are there ways to make houses safer against tsunamis? We are doing an experiment to test these ways and see if these minor changes can save many lives. To find a way to make cardboard houses stand up better to tsunamis and other big waves is the purpose of our experiment. We are going to try two different ways: we will angle one of the houses and we will put the other on high stilts. Our hypotheses are that the house on stilts is going to hold up the longest and that the angled house will hold up the second best.

Methods/Materials

We used 3 cardboard boxes, 8 short wood pieces, 4 long wood pieces, 6 flat wood pieces, 18 screws, and sand. Using these materials we built 3 cardboard houses and 3 wooden bases. We put the houses in the sand at the beach. We counted the number of waves until the houses got knocked over. We placed equal weight for each house (box and wood base) and repeated the experiment 3 times.

Results

In the first test run, all houses survived the first 16 waves. The 17th wave knocked over the angled and control houses, and the 19th wave knocked out the house on stilts. In the second test run, where we placed weight in houses by filling them with sand, all houses survived the first 17 waves. The 18th wave knocked out both the control and the angled houses. After 34 more waves, the house on stilts was still surviving and it possibly could have survived many more waves. In the actual experiment, we found that the control house survived 5 waves on average. The angled house survived 10 waves on average. The house on stilts was never knocked over. We stopped the experiment after 40 waves each time, but it might have lasted much longer.

Conclusions/Discussion

Both of our hypotheses were correct. The house with stilts held up the longest and survived the most waves. It never got knocked over. The house that was angled survived longer than the control house. The control house held up the worst. In poor countries we suggest they use stilts on their houses to make them survive better in tsunamis. If they can#t find the extra materials to make stilts, they should angle their houses to the waves.

Summary Statement

We test whether there are inexpensive changes that can be made to houses to make them survive tsunamis better.

Help Received

Father drove to beach and took pictures to record the experiment.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Nathan John Fay

Project Number
J0306

Project Title
Seizing the Tsunami Surge

Abstract

Objectives/Goals
The purpose of my science fair project is to see if a physical man-made structures built a barrier below the surface of the ocean will affect the energy of the tsunami waves before it hits the shoreline. If the structure can reduce the energy of the tsunami wave then there will be less damage and possible loss of life.

Methods/Materials
Built model wave tank (8ft x18 in): including clear acrylic model shore with scale of lines 8.6 mm apart from each other, model ocean floor covered with 6mm of plasticine modeling clay, mechanical wave-maker consisting of a wave-making flap, a pulley system, and an 11.4 kilogram weight.
1. Mount GoPro video camera on the side of the wave tank with the lens focused on the scaled lines of the model shore and film the water action.
2. Fill tank with dyed blue water.
3. Using mechanical wave maker, create a uniform tsunami wave. (Note: by fastening an 11.4 kilogram dumbbell through a pulley system to the wave-making paddle and created were the same from one test to another.)
4. Using the GoPro video, video the simulated tsunami wave as it hits the model shore. Print a screen shot.
5. Using the "line of the best fit" method, take a taut piece of fishing line, place parallel to the graduating scale and slide up or down to determine the weighted-average value of the wave's run up on shore. Record the measurements.
6. Test each man-made structure: one straight wall perpendicular to the wave's path and submerged 1 cm below the surface water, two V shaped walls, staggered walls, and then test one straight wall submerged in deeper water.

Results
The results of my experiment was that the shallow straight wall was the most effective in reducing the energy of the tsunami wave while the other three selected variables-the four staggered variables, two V-shaped walls, and one deep straight wall- had very little effect.

Conclusions/Discussion
After testing, I can conclude that a man-made straight wall structure submerge in the shallow ocean water would reduce the energy of a tsunami wave.

Summary Statement
Tests to see if a man-made structure submerged in the ocean can reduce the energy of a tsunami wave.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Mary Francis B. Garcia

Project Number

J0307

Project Title

Nod Alarm for Drowsy Drivers: The NADD Project

Abstract

Objectives/Goals

Drowsy driving is common and can cause fatal accidents and severe injuries. The purpose of this project is to design, build and test a special device, worn as a headpiece, to trigger an alarm as the driver nods off, in a simulated drowsy state.

Methods/Materials

Experiments were performed to find the best metal conductor for the Experimental Triggering Device (ETD). Four types of metal conductors were tested: copper, tin, alloy, and steel. Once the best metal conductor was found, the ETD was build with a hollow tube, 2 ball bearings, conductive wires, and a sound card. Mounting angles were tested using a protractor to determine the best angle the ETD will trigger an alarm. The ETD was then tested at a stationary position. It was also tested during actual driving conditions at different road grades, head movements and sudden stops, with the driver nodding off, simulating a drowsy state.

Results

Copper was determined as the best metal conductor for the ETD. The ETD was triggered best at a 40 degree mounting angle. At a stationary position, the ETD triggered consistently. During actual driving, the ETD, while tested in a simulated drowsy state, triggered reliably and consistently at different road grades. Except for sudden stops at 30 mph, there were no significant false alarms during head movements, and when driving over dips and humps.

Conclusions/Discussion

A prototype ETD was successfully designed, built and tested to alarm a driver as the head nods off in a simulated drowsy state under different driving conditions.

The ETD is a reliable and novel device that shows promise to reduce drowsy driving and potentially save lives.

Summary Statement

The central focus of this project is to design, build and test a device that will alarm a drowsy driver in a simulated drowsy state.

Help Received

Mentors: Richard and Nannette Hock provided advice in the materials used in the device, Edwin and Maria Garcia assisted in the building and testing of the device.

Name(s)
Benjamin A. Glazer; Larsen Weigle

Project Number
J0308

Project Title
Maglev Transportation

Abstract

Objectives/Goals
The purpose is to find out if maglev trains are more efficient than wheel trains.

Methods/Materials
We designed a track that allowed both maglev and wheel trains to be launched on it. Then we built the two trains for our testing. We tested both trains at multiple launch forces and measured how far they traveled. We used the data we collected from our tests to prove that either wheel trains or maglev trains are more efficient.

Results
The maglev train traveled further than the wheel train at all launch forces.

Conclusions/Discussion
We came to the conclusion that the maglev train is more efficient than the wheel train because it loses less energy per inch.

Summary Statement
Our project tests if a maglev train is more efficient than a wheel train, and therefore more practical for real-world use.

Help Received
We received help from one of our fathers with editing our writing to make sure it was understandable, with using a spreadsheet to analyze data, and with the construction of the track.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Nicholas A. Hern

Project Number

J0309

Project Title

Treads or Wheels? The More Efficient Option

Abstract

Objectives/Goals

The objective of this project is to measure robot efficiency when using treads versus wheels for first responder use in natural disasters or national emergencies. The goal of the project is to determine whether treads or wheels are faster and use less energy on various terrains selected.

Methods/Materials

To conduct this test, use LEGO Mindstorms EV3 set, 6 AA Eneloop Ni-HM batteries, 2 AAA Eneloop Ni-HM batteries, Volt Ohmmeter/Digital multimeter, metric tape measure, stop watch, screwdriver, and a computer. First, insert AA batteries into the power brick (central brick) and AAA batteries into the Remote IR control using a screwdriver. Build a robot that can be configured to switch from treads to wheels; it must include the head for the IR control. Second, use a metric tape, measure 3 meters of each terrain, asphalt, concrete, grass, dirt, and sand. Next, attach wires from the battery box to the Multimeter and set the multimeter so it provides energy readings every second in addition to the time it takes to complete. Run the robot through each terrain five times, stopping to input the data into the computer through an Excel spreadsheet. Once all tests are complete, switch treads for wheels and repeat all tests on the same terrain. Finally, construct a second robot configuration and run through all steps again to see if configuration plays a major role in efficiency.

Results

Robot 1, TRACK3R, and robot 2, GRIPP3R, were tested on five terrains. TRACK3R was able to complete all tests with treads and three tests with wheels. GRIPP3R was able to complete asphalt and concrete tests only. GRIPP3R was slower and used more energy than TRACK3R.

Conclusions/Discussion

Wheels were 19-21% faster and used 14-22% less energy when on concrete and asphalt. Treads were 100-123% faster and used 100-160% less energy on dirt, grass, and sand.

Summary Statement

This project is about finding the most efficient configuration for robots that can aid first responders in various situations.

Help Received

Mother helped proofreead and test; Father helped test; Mrs. Gillum advised and proofread

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Chayslin R.M. Johnson

Project Number

J0310

Project Title

Tsunami Barrier Designs and Their Effectiveness

Abstract

Objectives/Goals

The objective of my first year#s project was to determine if a barrier will lessen the impact of an average tsunami, and this year I continued and tested the effectiveness of different designed barriers against an average tsunami. Now that I know, from my year one project, that barriers protect against tsunamis, my goal this year was to determine which of my six barrier designs were most/least effective.

Methods/Materials

For my first year, my grandfather helped me design and build the wave box and wave mechanism that we used to test three trials with and without a barrier. For my second year project, my grandfather helped again with building another wavebox and wave mechanism. I expanded my testing this year by, designing six different barrier designs including a full barrier and no barrier. Each barrier design was tested against an average tsunami twenty times. The wave heights, for both years, were measured using chalk dust.

Results

My results for year one, was that the barrier was significantly better at lowering the wave heights of the tsunami. My results for year two, showed that Barrier #4 was most effective (not including full barrier) at lessening the impact of the tsunami. Barrier #2 was least effective (not including no barrier). I determined the effectiveness/results by comparing the average wave heights for each trial.

Conclusions/Discussion

My hypothesis for year one was correct because a barrier did lessen the impact of an average tsunami. My year two hypothesis was also correct in saying that Barrier #4 would do best and Barrier #2 would do worst. My year one project assured that barriers in the water will provide protection from tsunami barriers, and as I continued into my second year, my project confirmed that some barrier designs are more effective than other. Not only more effective, but some are more practical than others.

Summary Statement

Testing the effectiveness of various tsunami barrier designs in lessening tsunami impact.

Help Received

Grandfather helped build wavebox and mechanism.

Name(s)
Andrew T. Land

Project Number
J0311

Project Title
Timing Is Everything: Geometry of 2-Stroke Model Engines

Abstract

Objectives/Goals
To optimize the performance of a 2-stroke model airplane engine for a specific application (e.g. high rpm for speed), the geometry of an engine's timing must be understood. Timing numbers can be determined by the position of the ports in the cylinder. Engine designers must know how to turn target timing numbers into dimensions for making or modifying a cylinder. In this project I set out to determine an equation linking the position of the piston in the cylinder and the crankshaft's angle of rotation, and to compare it with actual measurements.
OBJECTIVE: Derive an equation D(theta) that will solve for the piston's position in the cylinder for any angle of the crankshaft's rotation.

Methods/Materials
I derived a trigonometric equation for D(theta) from first principles. A Rossi-15N model engine was measured using a depth gauge and a circular protractor. I also derived the reverse equation Theta(D) which exactly calculated the inverse results from D(theta). Microsoft Excel was used to calculate solutions for the equations and to compare these with experimental data.

Results
Replicate depth versus angle data sets were measured, with averaged data plotted to compare with calculated values. Agreement between theoretical and measured results was excellent. I graphed a "difference plot" to look for any systematic errors, which suggested interesting possibilities. The effect on timing curves from changing the rod length was investigated using my derived equation.

Conclusions/Discussion
The equation derived for D(theta) matched the experimental data very accurately, meeting my objective. I now have an accurate method for designing and modifying my model engines for improved performance.

Summary Statement
By determining equations to define a 2-stroke engine's port timing, accurate design and modification of cylinder ports can be achieved.

Help Received
My Dad provided the engine and tools to measure it with, help with the computer graphics, and showed me how to use Microsoft Excel.

Name(s)

Paul C. Lauermann

Project Number

J0312

Project Title

The Effect of Trebuchet Arm Length on the Distance an Object Is Thrown

Abstract

Objectives/Goals

In medieval times, the trebuchet was preferred over the catapult because its design allowed for longer and more accurate throws. This simple mechanical machine uses a hinged counterweight attached to a rotating lever arm to throw heavy objects long distances. My hypothesis was that an object could be thrown farther using the mechanical advantage generated by using a longer trebuchet arm. To test this, I built a trebuchet and varied the lever arm length to determine the effect it had on the distance an object was thrown.

Methods/Materials

Three trebuchet arm lengths were tested as part of my project: 120 cm, 90 cm, and 60 cm. The trebuchet I used was constructed out of 3/4 in. and 1 in. PVC pipe and fittings and was based on a design I found online. A plastic bucket filled with 6.8 kg of gravel was used as the counterweight and a standard tennis ball attached to a string was used as the object being thrown. To measure the distance the ball was thrown, a 30 m measuring tape was attached to the base of the trebuchet and pulled to the object where it first landed. To keep the angle of the trebuchet arm the same, the base on which the ball and string were laid, as well as the firing pin, were raised with each change of arm length to keep all distances and angles proportional. The trebuchet was fired ten times for each of the three arm lengths and the data was averaged.

Results

The 120 cm arm threw the farthest with an average distance of 21.20 m. The 90 cm arm was only a few meters less with an average distance of 19.96 m. The 60 cm arm had a drastically shorter distance of throw, averaging only 9.36 m. This showed a 6% reduction in distance thrown between the 120 and 90 cm arms and a 56% reduction between the 120 and 60 cm arms. It was also noted that the 60 cm arm had a more vertical throw than the other two arm lengths.

Conclusions/Discussion

The data collected supported my original hypothesis that a longer arm length would throw an object farther. While this relationship is not linear, to achieve maximum throw distance a longer arm would have to be used. Even though testing showed arm length to be an important aspect of distance thrown, there are other potential factors of the design that could also have affected my results including the angle of the throw (tennis ball string length) and the weight of the counterweight (too heavy or too light, affecting the velocity of the arm).

Summary Statement

The purpose of my project was to determine the affects of trebuchet arm length on the distance an object is thrown.

Help Received

Father helped construct trebuchet, Mother helped measure distances.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Bridget J. Macmillan

Project Number

J0313

Project Title

The Effect of the Mount Point of a Parachute on the Ride Height of an Acura RSX Land Speed Vehicle

Abstract

Objectives/Goals

The purpose of my experiment was to determine the best location for the mounting point of a parachute in a Landspeed racing configured Acura RSX. The best location would be determined by the least movement of the front and rear ride heights under parachute deployment.

Methods/Materials

I predicted that mount point three, the mount point that appeared to line up with the center of gravity, would have the least movement as measured by the ride height sensors. I tested my hypothesis by creating an adjustable parachute mount assembly and tested five different mount height points under parachute deployment at 100mph. The testing was conducted at the El Mirage Dry Lake Bed, 40 min from Victorville on Jan 5th and 18th.

Results

I found out that my hypothesis was correct; mount point three located 22.25 in (56.515cm) above the ground delivered the most stable results. Mount point three pulled straight through the center of gravity, so when the car unloaded, there was less of a weight transfer.

Conclusions/Discussion

I concluded that mount point three pulling through the center of gravity would unload the vehicle in such a way the ride heights remain constant. The parachute, being lined up with the center of gravity does not force the rear either up or down.

My findings can be applied directly to other Landspeed racing vehicles and in fact there are two other vehicles waiting to apply my results to their parachute mounts. The findings are also relevant to drag racing, especially the import drag scene that also use front wheel driven vehicles, similar to the RSX.

Summary Statement

My project investigates the change in ride height of an Acura RSX land speed vehicle as the parachute is pulled.

Help Received

My father drove the vehicle, Steve Davis fabricated the parachute mount device from my design

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Henry A. Mason

Project Number

J0314

Project Title

Make It or Break It: How Do Different Filaments and Fill Patterns Affect the Strength of a 3D Printed Object?

Abstract

Objectives/Goals

This project's objective is to compare the strengths of 3D printer plastics and internal structures under a variety of stresses: shear, torsion, flexure, and tension.

Methods/Materials

Using a Solidoodle 2 Pro 3D printer, I created hundreds of rectangular prisms using PLA and ABS printer filaments, and for each of those plastics, the objects' internal structure (of 20% density) was honeycomb, rectilinear, or linear. Using clamps and simple wood test devices, I applied flexure, shear, torsion, and tension stresses to each of the objects and recorded the maximum reading from the fish scale I used to apply the force to the objects.

Results

The results showed that for both plastics, the honeycomb pattern was able to withstand greater forces than the linear and rectilinear. The experiment also found that PLA filament consistently withstood greater forces than ABS. The prints made with PLA filament with the honeycomb fill pattern were stronger than prints made with other fill patters, except for ABS, with its linear structure being slightly stronger in my flexure tests.

Conclusions/Discussion

This examination of the behavior of two different 3D printer plastic filaments and three different fill patterns when under a variety of stresses demonstrated that - even when the amount of plastic used in the object's fill is of the same density - a honeycomb pattern tends to provide the greatest strength. Limitations of the software I used for printing - Slic3r and Repetier Host - did not allow it, but I would have liked to try a triangular fill pattern, because I think that would be even stronger than the others. Also, I was gratified to find that the biodegradable PLA plastic actually proved generally stronger than the recyclable but not biodegradable ABS plastic.

Summary Statement

My project investigates how different 3D printing plastics and fill patterns stand up to a variety of forces.

Help Received

Dr. Daniel Fernandez, CSUMB, for asking the question of this project; my father cut parts for my test devices and ran the 3D printer; Mr. William, OSH, for suggestions in designing test devices; Mr. Richard Herbert for the suggestion of a fish scale.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Callie M. McCaffery

Project Number
J0315

Project Title
I See Cantilevers Everywhere

Abstract

Objectives/Goals
What affects how much a cantilever arm will bend?
Specific test: How will changing the length of a cantilever arm affect how much the free end moves with the same weight?
Hypothesis: If I lengthen a cantilever arm it will bend more than when it is at a shorter length.

Methods/Materials
I am going to test my hypothesis by increasing the length of a cantilever arm with the same amount of weight on the end. I will measure the deflection of the cantilever arm from the horizontal at each length.
Materials: Sticks (dowels) for testing as cantilever, clamps, five-pound weight, level surface to support cantilever and measuring device (saw horse), level with ruler, T-square, flashlight, tape, zip ties, pencil and paper.

Results
Table of data showing measurements of deflection for cantilever lengths from 2" to 24". Deflection increased as length increased with the same weight. Also tested different shaped (circle and square) rods/cantilevers. Found square rod bent less than circle rod.

Conclusions/Discussion
My hypothesis was correct. The longer the cantilever arm, the more the rod will bend.
I learned there are a lot of cantilevers around, man made and natural. I even discovered I can be a cantilever by stretching my arms out and holding a weight.
Other variables that I can change in further testing of cantilevers could be shape of rod, coatings on wood, weights used, and since visiting with judges, I have thought about questions on the impact of density, and cross sectional area.

Summary Statement
My project is about changing the length of a cantilever arm to see what effects it has on the deflection distance.

Help Received
Father helped build test set up; mother and father helped with data recording and computer work

Name(s)

Logan K. McWilliams, III

Project Number

J0316

Project Title

Tsunami Cloak

Abstract

Objectives/Goals

Tsunamis kill thousands of people and cause billions of dollars in damage each year, so I decided to test if it was possible to protect vulnerable shorelines from large destructive waves. When I researched tsunamis I found a science journal that was discussing abnormally long wave lengths that are attributed to tsunamis in the same journal I found a device, by a French scientist, that diverted light waves away from a certain object and therefore making the image of that object distorted or non-existent. I thought I could use the basic design of the device with wooden pillars arranged in a circular array that got smaller towards the middle. I thought that if I built a replica of the device out of wood it could divert a water wave the same way that it diverted a light wave and it could redirect a tsunami away from a city.

Methods/Materials

To test this I built a wave tank that was made of wood and had been fiber-glassed to make it waterproof. Once I had built the wave tank I filled it tank to three inches deep and set a ruler at the far end of the tank to measure the wave heights of each wave. To make the wave I let fall a piece of wood from a set distance. I made twenty five wave without the device in the tank and recorded all of the wave heights. I repeated the test in the same manner with the device in the tank.

Results

My hypothesis was partially incorrect due to the fact that originally I thought that the wave would be totally redirected, but in reality it just slightly decreased the size.

Conclusions/Discussion

My conclusion was that even though my original hypothesis was proven incorrect the experiment was a success because I learned that this device can successfully decrease the size of a wave and maybe save city's such as Fukushima in Japan in the future.

Summary Statement

The test of a "Tsunami Cloak" to divert large wave away from a coastline.

Help Received

Father helped type report and build wave tank,

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Wyatt G. Metelman Alvis

Project Number

J0317

Project Title

The Effect of Different Impact Absorbing Materials on a Simulated Human Head Model

Abstract

Objectives/Goals

My project was to determine if different impact absorbing materials affect the impact force on a simulated human head model. My hypothesis was that the impact force would be lowered using bubble wrap as an impact absorbing material.

Methods/Materials

Materials: Bubble wrap, Styrofoam, cotton fabric, cardboard. Human head model: iPhone with accelerometer app (Accelerometer Data, Wavefront Labs) inside pencil box. Methods: Gravitational force (G force) was measured, using the accelerometer app, on the iPhone placed inside a pencil box as it was dropped from 0.5M and 1.0M. Five trials from each height, for a total of ten trials, were measured and used as controls. An additional five trials, at each height, were measured for each of four impact absorbing materials surrounding the iPhone, inside the pencil box, for a total of 40 experimental trials. The accelerometer data, from each control and experimental trial, was captured using WiFi and sent to the computer. Mean, standard deviation, ANOVA and student's T-test statistics were applied to the data.

Results

Combining and averaging the data from the two heights, the bubble wrap had the lowest impact force (mean 1.52G) on the simulated human head model and the cardboard had the greatest impact force (mean 2.03G). The overall average impact force of the control was 1.78G. The bubble wrap reduced the overall mean impact force 15% and the cardboard increased the overall mean impact force 14% as compared to the control. The variability of results, as estimated by the standard deviation, ranged from 22-32% of the mean. A one way analysis of variance (ANOVA) showed no statistical difference of impact force in the 0.5M group, but did show a difference in the 1.0M group ($p=0.0005$). A student's t-test (1.0 M group) determined bubble wrap to have the greatest reduction in impact force on the simulated human head model compared to the other materials.

Conclusions/Discussion

My results showed that different absorbing materials changed the impact force on a human head model. The results also supported my hypothesis that bubble wrap, as an absorbing material, decreased the impact force (15% compared to the control) on the human head model. This data may contribute to the material design of future impact absorbing helmets.

Summary Statement

Different absorbing materials change the impact force on an experimental human head model (iPhone and accelerometer app).

Help Received

My science teacher LeighAnn Work and my father, Mark Alvis, who helped guide me through the project. Mr. Yves Arramon and Mr. Rob Chiasera for help with understanding the impact force data.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Francis Y. Pan

Project Number

J0318

Project Title

Car Performance

Abstract

Objectives/Goals

The goal of my project is to see whether a shorter or longer wheelbase is more efficient for driving. If cars can turn efficiently, then it will save time and energy.

Methods/Materials

One model LEGO Mindstorms car with an adjustable wheelbase was constructed. The car could be remodeled with wheelbases of 18,22, and 26cm. The car was programmed to run through a pre-made course using a color sensor. Each wheelbase was tested 10 times for maneuverability (timed in seconds) and turn radius (measured in cm). All wheelbases were the same in weight, and ran the same program and course.

Results

The shorter wheelbase had the best maneuverability, and the mid-length wheelbase had the worst maneuverability. The turn radius increased with the wheelbase.

Conclusions/Discussion

My conclusion is that wheelbase does have an effect on car performance and that a shorter wheelbase would result in better maneuverability.

Summary Statement

This project tested whether a car's wheelbase effects its maneuverability.

Help Received

Dr. Tseng provided research information and feedback.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Quin Parker

Project Number
J0319

Project Title
Water Tower Shakedown! The Effect of Base Isolators on Linear Acceleration

Abstract

Objectives/Goals
The US Geological Survey has charted that on average 3,600 earthquakes have occurred in the United States between the years 2000 and 2012. This creates a constant need for stronger and more earthquake-resistant structure designs. I decided to further investigate this need by studying the effects of base isolators in reducing the linear acceleration of a structure during an earthquake. My objective was to determine the most effective base isolator at reducing the average linear acceleration of a water tower during seismic activity.

Methods/Materials
A shake table was constructed, powered by a standard electric drill. A model water tower was constructed out of an Erector set. An iPad running the application, Sparkvue, was used to record the linear acceleration of the water tower when the shake table was running. There were four positions of the iPad around the shake table. Five base isolators (whiffle balls, golf balls, tennis balls, ball bearings, and felt sliders) were tested ten times for ten seconds each in all the positions. Average and maximum data points were recorded from each run to compare acceleration.

Results
The results showed that the tennis ball base isolators had an overall average of the averaged means of linear acceleration of 1.7506 m/s/s, which was the lowest out of the five base isolators. The remaining base isolators in order from the most to least effective were whiffle balls, golf balls, ball bearings, and then felt sliders.

Conclusions/Discussion
After studying base isolation technology, it seems that base isolators with the characteristics and features of a tennis ball would appear as the most beneficial solution to reducing linear acceleration during earthquakes. This proves that my hypothesis was correct. I think this knowledge will greatly help engineers and contractors create safer structures, such as water towers.

Summary Statement
The project was conducted to determine the most effective base isolator at decreasing overall linear acceleration of a water tower during seismic activity.

Help Received
My father helped construct the shake table, buying supplies, and turning on and off the drill when data was being collected; my science teacher, Mr. Ennes, introduced the Sparkvue application to me; my mother helped type up the backboard material.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Tyler Pelascini; Jacob Smith

Project Number

J0320

Project Title

Crack of the Bat, Not Crack of the Skull! A Study of Pitcher's Protective Headgear

Abstract

Objectives/Goals

Head injuries are a serious issue in professional sports, especially in baseball. The pitcher is the most vulnerable position for injury, and Major League Baseball does not require pitchers to wear any protective gear. Standing 60 feet, 6 inches away from home plate, screaming line drives are hit at pitchers at up to speeds of 110 miles per hour. Injuries can include broken noses, ruptured eye sockets, and most importantly, concussions. In an attempt to find a remedy for this problem, we took protective materials that could act as hat liners, and tested how effective they were at protecting a pitcher#s head.

Methods/Materials

We tested the hat liners in two different ways. In the first test, we took each liner, positioned it around the hat, and placed it over a melon. We then fired a pitching machine#s pitch at the melon#s front, back, and side, and measured the diameter and depth of each crater. Our linings included two hard hats, one with foam and one without, a kitchen bowl, football helmet padding, ice gel packs, Kevlar from a bullet proof vest, and for comparison, one with no protection. In our second test, we put each of the hat liners on a bowling ball, surrounded the ball with a sphyganometer (blood pressure cuff), and set it to 200 mmhg. We then dropped a 4.5 kilogram weight on the ball and observed the spike of the air pressure upon impact.

Results

In the impact damage experiment, the Kevlar only allowed a 1 centimeter wide and 1-centimeter thick crater when fired at from the back, and didn#t allow a crater from the front and side. No other lining came within a full centimeter in both measurements. In the pressure experiment, the football pads produced the best results, allowing 20 less mmhg than the second place finisher.

Conclusions/Discussion

We think that the Kevlar won the impact damage experiment because Kevlar is used in bulletproof vests, making a baseball at high speeds a cakewalk for the Kevlar. However, Kevlar is rather thin, and was not able to radiate out the pressure of a 4.5 kilogram weight as effective as the dense football padding in the pressure experiment. We learned through this experiment that strength protects against impact, but density protects against pressure. We suggest Major League Baseball get with the program, and require pitchers to wear a cap with a Kevlar padding lining. It would save injuries, careers, and even lives.

Summary Statement

In order to prevent possible brain injuries, baseball pitchers should wear a padded Kevlar hat liner.

Help Received

Arcata Little League provided the pitching machine; George Cavinta provided the Kevlar

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Leonardo E. Pena

Project Number

J0321

Project Title

Human vs. Robot

Abstract

Objectives/Goals

The objective of my project is to show the comparison between robots and humans in the real world. One of my major goals during my science project was to prove that robots can keep up with humans with today's newest technology. Another major goal was to show how easy it can be to build, maintain, and make a robot function with today's modern technology.

Methods/Materials

For my tests, I will completed a total of 15 tests for each side. The human side had to sort lego bricks into cups but once they drop the lego(into the cup or on the table), they may not pick it up again because the robot does not have that capability. For the robot, I simply activated it and let it follow it's program. The materials I used to build my robot where: 286 lego pieces that came from the Mindstorms NXT 2.0 kit(NXT block "the brain", wires, studs, beams, and rods). For my testing I will need 12 different lego bricks, 8 cups, and my test subjects.

Results

With my testing of my robot, I found that it is about three times slower than a human but is about 89% more accurate. I found this by studying my results and figuring out what would be better for the world.

Conclusions/Discussion

From my data results, I have derived that robots have won the competition between the battle of Human VS Robot. However, just from the data I have received from tests, I can still say "never underestimate the power of a human being." I can also say the same about a robot with ease as well. While human came up three times faster than the robot, robots were far more accurate.I can now infer that people would prefer a longer wait with more accuracy than a shorter wait with very little accuracy to receive their medication. Ever since I have gained interest in robotics, I have always wondered what is better for the challenging tasks that the world provides, humans or robots and I finally found my answer.

Summary Statement

My project is about the comparison between the efficiency of robots and humans.

Help Received

Father helped with backboard; family and teacher Mrs.Urbiztondo provided encouragement.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Shreya S. Ranganath

Project Number
J0322

Project Title
A Sandwich Stops Bullets!

Abstract

Objectives/Goals
There is nothing more precious than life! Yet, in the United States and around the world, many lives are being lost because of senseless killings due to possession of high-powered rifles and bullets in the hands of bad guys. My Science and Engineering project on a "composite sandwich" shows how to blunt these attacks and protect what we truly value the most.

Methods/Materials
Various kinds of materials were tested - high-strength steel, aluminum, hard ceramic facing, and especially fabricated novel single- and double-layer composite sandwiches # against 9 mm, 10 mm (.40 caliber) and 5.56 mm high speed bullets. The depth of penetration on a back-up steel was measured in each test. An effort was then made to relate the Areal Density, i.e. the weight (kg) per unit area (m2) of material necessary to provide full protection, with the properties of the metals and composites. The analysis of results seem to prove the hypothesis: "That if ceramics such as Alumina (Al203), which are brittle and easily breakable under tension, could be bonded with a tougher backing material in composite construction, then the high hardness, elastic modulus and compressive strength of this ceramic could fracture or mushroom the head of the high speed bullets upon impact. If this were to happen, the backing material would then deflect to absorb the remaining kinetic energy (1/2 mv2) and stop the bullets and ceramic fragments."

Results
Fractographic observation of the bullets and the target further helped in designing and fabricating the best lightweight and most cost-effective bulletproof armor composite. It has been shown in this research that the double-layer ceramic facing composite with carbon-fiber backing will be more than 3 times lighter than Aluminum and Steel in providing same level of protection against all three types of bullets.

Conclusions/Discussion
I'm hopeful that the fruits of my research and development would find additional noble applications in blast-proof shelters and aircrafts, bullet proof safe-enclosures in schools, impact-resistant cars/choppers, neutron radiation shielding tanks, acoustic panels, and home insulations...for these, please stay tuned!

Summary Statement
A cost effective lightweight novel composite has been produced in this project which provides full protection against bullets, and could easily be tailored for potential applications in aerospace, automotive, defence and electronics.

Help Received
Used equipment at DA Graphite Inc to cure laminate; Retired Police Officers helped test the fabricated composite in my presence at the American Shooting Center, San Diego.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Tyler E. Robertson

Project Number

J0323

Project Title

Commotion in the Ocean: The Effect of Wave Barriers on Tsunami-Induced Seiche Waves

Abstract

Objectives/Goals

The goal of this experiment was to determine the effectiveness of different wave barriers at different locations on a tsunami-induced seiche wave.

Methods/Materials

A wave tank was constructed using PVC pipe, clear vinyl sheet, and duct tape. Two barriers were constructed using painter sticks and hardware. The other two barriers consisted of a flat brick and a brick placed vertically on its long side. A tsunami wave was generated by pushing a cookie sheet forward eight inches from one end of the tank. Each barrier was tested 10 times at three predetermined locations within the wave tank that corresponded to three points within a standing wave. Each trial was videotaped from 3 different angles and timed with a stop watch.

Results

Using video analysis, wave amplitude, speed, and power were calculated at each of the 3 data points. Each wave's dissipation time was determined by measuring the time from the wave initiation to the time the wave's crest and trough diminished below a preset level. The results demonstrate that the flat brick was the most effective barrier at the standing wave node. This barrier reduced wave power by 54.43% at point 1, 99.59% at point 2, and 100% at point 3 compared to the control. The vertical brick simulating a sea wall had the fastest energy dissipation time but demonstrated increased wave power at barrier positions 2 and 3. The barrier with the brackets showed little change in energy dissipation time compared to the control, but was effective at reducing wave power 73.5% to 84.9% at data point 3 (the point closest to "shore"). The brick barriers were more effective when they were farthest from shore, while the smaller barriers were more effective closest to shore.

Conclusions/Discussion

The location of a wave barrier determines its effectiveness against tsunami waves and tsunami-induced seiche waves. The hypothesis was not supported through the experiment. The increased wave power noted for the seawall brick was likely due to wave reflection and interference. The barrier with the attached brackets reduced wave energy effectively and could be a practical alternative for protecting shorelines with minimal impact on marine life. Further research should explore what plays a greater role for a barrier: the position within the seiche wave or the position relative to the shore.

Summary Statement

This experiment explored the effectiveness of wave barriers at different locations on tsunami-induced seiche waves.

Help Received

Mother built the wave tank, helped type report, and was the wave generator for the experiment. Father helped with math and wave power formulas.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Aurora A. Santillan

Project Number

J0324

Project Title

Tsunami, Reducing the Damage: Testing Barriers and Non-Traditional Structural Designs

Abstract

Objectives/Goals

The objective of my project was to investigate ways of reducing tsunami damage to pinpoint the most effective means of doing so.

Methods/Materials

My wave tank was made from a 40 inch long plastic tub; a secured wave-paddle, made out of cutting boards, a wooden dowel and duct tape. I built the shore using wet-foam and structures using craft-sticks and wood glue.

For each test, I made waves with the tub filled to 1 inch, 2 inches, and 3 inches; the most dramatic structural results always coming from 3 inches of water, as this produced "sea-level" land; though 2 inches had the best-looking waves in the small tub.

Results

In my research I found that elevating structures, building sea walls, and growing reefs and mangroves can all have a major effect against the power of tsunami. I also found that changing the orientation of buildings, the direction the walls faced the shore, could produce a structure that can better withstand tsunami forces. It was this observation about orientation that gave me the idea to design a building that was diamond shaped; reducing the surface area forces of the impact. Just as the bow of a ship moves through water, the diamond shaped house didn't experience nearly as much impact force as the standard shaped building.

Conclusions/Discussion

Elevating structures was the most effective means of reducing damage. While other methods can greatly reduce damage due to impact forces of a tsunami; elevating, or building away from coastlines altogether, is the only solution to avoiding the costs and burdens of damages due to flood water.

Summary Statement

Testing various methods for reducing the damages caused by tsunami.

Help Received

My teacher encouraged us to go to the science fair and gave me the information and support I needed to do this project. My whole family helped me with my project at home, from running trials to printing photos.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Anshul Singh

Project Number
J0325

Project Title
Wind-Proofing Bridges Prone to Hurricane Winds

Abstract

Objectives/Goals
Bridges located in hurricane-prone environments can suffer extensive damage in the forces of a hurricane. The objective of this project was to design a small-scale bridge deck that would limit drag experienced by the bridge deck to a minimum.

Methods/Materials
The experiment employed a home-made wind tunnel that was used for testing. The bridge deck's drags were recorded using springs mounted on the bottom of each bridge. The distance that each spring stretched in testing was recorded, and using Hooke's Law (F=K*X), a principal that was used to compute the drag experienced by each bridge, which is represented by the K variable. The F variable in the formula was the deck's mass, the X variable was the spring stretch length in testing, and the K variable was the computed drag in the formula. Three speeds were used which encompassed 3, 5, and 8 mph of wind. Each one of the four bridge designs was tested in the wind tunnel at each speed 10 times.

Results
Based upon visible observations, the first bridge, the control bridge, performed very poorly throughout all three of the speed tests and did the worst based upon visible observations. The second bridge, a bridge that had curved outriggers, did a little bit better than the first bridge in the speed tests. The third bridge, a bridge that employed curved outriggers and weights on the bottom of the bridge did better than the second and first bridges. Finally, the fourth bridge, a bridge that employed curved outriggers and a deck roof, performed the best out of all the other bridges based upon visible observations.

Conclusions/Discussion
After computing the experienced drags of each bridge deck using Hooke's Law, many conclusions were made. In a constructed overall line graph, encompassing all three speed tests, the second bridge did the worst out of all of the bridges in terms of experienced drag. The fourth bridge did the best out of all the bridges in testing. This happened because the fourth bridge had the least drag, meaning that bridge four was the most streamlined design out of all the bridges and it would perform the best in a hurricane environment out of all the tested bridges. Therefore, the conclusion made was that the more streamlined a bridge deck is, the better the bridge will perform in a hurricane environment.

Summary Statement
Bridges in hurricane-prone environments can suffer extensive damage or can be destroyed in hurricanes and this project is out to solve this problem.

Help Received
Neighbor helped cut materials; Parents helped provide materials; Teacher helped to edit notebook; Mentor helped to provide intellectual knowledge.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Anjali Sinha

Project Number

J0326

Project Title

Quake'n and Shake'n: An Earthquake Experiment

Abstract

Objectives/Goals

Earthquakes turn up out of the blue and we need to be prepared.I wanted to know what materials for joints would be best and what reinforcements would work well with them. I hypothesized that if the joints of the buildings had both flexibility and sturdiness, it would last longer, and that if a double crossed truss was applied to a building, the building would stand for a longer period of time.

Methods/Materials

Using various items including wood, washers, a drill, and other metallic materials, I constructed a shake table on which my buildings could undergo their tests. I made buildings with gumdrops and toothpicks and another set with jumbo marshmallows and Popsicle stick and shook them on the simulator and recorded my results.

Results

After finishing the experiments, I found that if the material at the joints is sturdy while flexible (gumdrops), the structure is more stable by 685%. Stability is also increased by 364% when the double crossed trusses are used in the building. After testing each building twenty times (in two sets of ten), I can say that the gumdrop buildings and the double crossed reinforcement truss buildings stood for about 50% or an average of eighteen seconds (or more) longer than the others. Without any reinforcements (control test), the gumdrop buildings stood for 13.351 seconds and with the double crossed trusses, these buildings lasted for 60.976 seconds. The marshmallow buildings originally stood for 1.701 seconds and with the double crossed truss, for 33.445 seconds.

Conclusions/Discussion

Based on the data collected during my experiment, my hypothesis, that the gumdrops and double crossed trusses would work best, was proven correct. The gumdrops did indeed work best; they are slightly flexible but very sturdy. The marshmallows were flexible but not that sturdy and collapsed easily, especially when without reinforcements. The double crossed trusses stood out as the best reinforcement across the line. Outdoing all other variations, the double crossed lasted much longer. The cross gave the structure more support and contained all of the walls even if they started protruding. During the first few experiments, I encountered a few problems that included the structure of my buildings as some of them would just come undone or fall down without even being through the shake table but I found ways to resolve these. This year I am glad to have researched something beneficial to society.

Summary Statement

After researching on the topic of earthquakes, I wanted to find out how the stability of a building during an earthquake is affected by the material of its joints and the reinforcements used in building it.

Help Received

Father helped build shake table; Mother helped time the experiments; My teacher helped by giving me feedback and pointers

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Anna E. Spangrud

Project Number

J0327

Project Title

A Comparative Analysis of Different Bridge Spans

Abstract

Objectives/Goals

The goal of my project was to find out what types of bridges can hold the most weight, and which are best for different distances.

Methods/Materials

Popsicle sticks, glue, wire, and string were used to build a truss, cantilever, and suspension bridge. Each of the nine bridges were placed across two tables, and below them I suspended a bucket, to which I added weight until the bridge broke. I then weighed the bucket to see how much weight each bridge had held. I repeated this process three times for each bridge.

Results

My results show that the Suspension Bridge held, on average 14.6 pounds, the truss 11.3 pounds, and the cantilever 8 pounds.

Conclusions/Discussion

My experiments proved my hypothesis right, I thought that the suspension bridge would hold the most weight, the cantilever the least, and the truss somewhere in the middle. I think that the Suspension bridge could be used for carrying heavy loads a far distance, where as the truss or cantilever would be better to be used for shorter distances or lighter loads.

Summary Statement

For my project, I tested which type of bridge could hold the most weight.

Help Received

My father let me use his apartment to do my tests in and helped take pictures while I was testing.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Dylon M. Tjanaka

Project Number

J0328

Project Title

Using Active Tilt Compensation to Improve Rollover Stability of Large Trucks

Abstract

Objectives/Goals

The objective of this project is to reduce rollover accidents involving large truck by engineering an Electronic Stability Control system called Active Tilt Compensation (ATC). ATC detects tilt using an accelerometer and moves the truck center of gravity to compensate for the tilt.

Methods/Materials

I derive the equations that describe the conditions that cause large trucks to rollover. Then I use Lego Mindstorms kit to build an intelligent truck trailer. This trailer has a 3-axis accelerometer and the capability to move its load to shift its center of gravity. Next, I write a program to read back the acceleration values, filter the data using median filters, and move the trailer load to compensate for rollover force. I test the truck behaviors under static (non-moving) conditions on a ramp. The ramp angle is measured using a tilt angle app running on an iPod. I also test the truck behaviors under dynamic (moving) conditions on a test track with a known radius. I use my razor scooter to tow the truck trailer. I use a camera and stopwatch to measure the speed of the trailer turning on the test track.

Results

I use equations to compute expected values and correlate the values to experiment results. Under static conditions, the trailer moves its load if it is about to reach the critical tilt angle that will cause rollover. The average error between computed and measured critical tilt angles is 2.18%. Under dynamic conditions, the trailer moves its load when the accelerometer indicates that it is about to tilt. I create various test cases to measure the response of the ATC system. The test cases include a scenario that will cause the trailer to rollover. The system works as expected under dynamic conditions.

Conclusions/Discussion

I have successfully implemented the Active Tilt Compensation mechanism. My experiments agree with my theoretical derivations within reasonable errors. My model truck trailer reacts to external forces to compensate for rollover conditions. I find out that I have to use median filters to utilize accelerometer data effectively. I believe that my project will be useful to reduce rollover accidents involving large trucks. However, I also believe that I could still make future improvements, such as using a PID controller to shift the center of gravity.

Summary Statement

I am designing, constructing, testing, and analyzing the Active Tilt Compensation system that can be used to improve the rollover stability of large trucks.

Help Received

Ms. Woodward (Science Teacher) helped with science fair preparation; Bryon Tjanaka (Brother) helped me solve difficult Science and Math problems; Mother provided critical opinions and advice; Father provided technical advice and direction.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Timothy A. Valadez

Project Number

J0329

Project Title

Virtual Images: The Science behind Pepper's Ghost

Abstract

Objectives/Goals

The principal goal of this project was to create virtual images on a model scale using Peppers ghost technology. Several parameters within this broader goal were examined with distances, backgrounds, lighting, and materials to achieve a viable image. This idea has application in several industries using illusions such as the Haunted Mansion at the Disney parks.

Methods/Materials

I used a small box to create a room. A dark surface of flat black was prepared inside the box. I initially tried using a CD case for a transparent panel or wall. The CD case was placed open on its side at a 90 degree angle with a dark surface of black construction paper attached to one side, and the opposite side remaining transparent. An LED light source was affixed to the back of the transparent side. A model figure of a ghost made of white material was place in the forward portion of the box in front of the light source. A background scene for contrast was placed the rear area of the box with another small light source to illuminate the background. Cut a small square shaped opening (about 6 centimeters) on the end of the box closest to your forward light source. A light switch was then installed. With a lid installed, I then turned the forward light source on and off and rated the quality of the illusion with the ghost appearing and disappearing. Variables with light intensity, background and subject color contrasts were made.

Results

My observations indicated that the darkest backgrounds within the model and the brighter the lights I used in the forward portion of the box yielded the better images.

Conclusions/Discussion

My goals were initially met of being able to create the ghost image. I found that darker backgrounds and a brighter light illuminating the ghost image produced the best contrasts with the materials available to me. I am continuing experimentation with transparent and reflective materials to improve both the transparent and reflective qualities of the images.

Summary Statement

This project examines virtual images created with several parameters of reflected and transparent surfaces on a small scale model using Pepper#s Ghost illusion technology.

Help Received

My father helped me assembled some key areas of the project. All other work was mine.