CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)

Dane Adams; Derek Hanes

Project Number

S0301

Project Title

Secret to Stealth

Abstract

Objectives/Goals

When one sees the B2 bomber,or the F-117,they might notice the abnormal shape of these aircrafts. One might also notice that they are always black or dark colored. Do these shapes and colors make these planes harder to detect? Radar and sonar are used to detect objects that can#t be seen by the naked eye. This test is designed to reveal which shapes and colors make a plane stealthy.

Methods/Materials

In this project,a cardboard box was used. 20 pieces of paper,5 red,blue,yellow,white and black were folded into four shapes:cylinders, crumpled cylinders,V-shapes,and W-shapes. The box was painted black. A lux meter,light meter, was used to measure the light. Each shape was individually tested. They were placed in the box in a room pitch black dark. A hole was cut for the flashlight. The lux meter censor was placed inside the box. The light was turned on and the number (amount of light reflected back) was recorded. The LED flashlight was turned off after each test.

Results

After all testing, the black W-shape reflected the least amount of light, 0.05 lux. The rest of the shapes are as follows: black V- .2, red W- .35, black cylinder- .4, black crumpled- .5, red cylinder- .6, red V- .6, red crumpled- .7, blue crumpled- .7, blue V, .7, blue W- .775, blue cylinder- .8, yellow crumpled- 1.4, yellow V- 1.4, yellow W- 1.4, yellow cylinder- 1.5, white cylinder- 2.7, white crumpled- 2.7, white W- 2.8, white V- 3.4.   Black overall was the best color; reflect in an average of 0.2875 lux. White was the worst color; reflecting an average of 2.85 lux.

Conclusions/Discussion

Black was the most effective. This is understandable because black absorbs almost all light. Also understandable is that white was the least effective because white reflects almost all light. The W-shape was the best shape because of its angles. The angles scattered the light in other directions,not at the censor. Maybe that's why the B-2 bomber is flat and black. Maybe that is why the F-117 is blackand blocky shaped. Pilots say that these two planes are very hard to fly because they are not very aerodynamic. Is the trade off in aerodynamics for stealth,and maneuverability for undetectability worth it? In fact,most stealth aircraft are meant to carry large payload,and were not equipped for air to air combat,so maneuverability was not one of the main concerns. The trade off is definitely worth it.

Summary Statement

To test which shape and color make an aircraft stealthiest.

Help Received

Mother helped with board; Dad bought lux meter; Mrs. Lewis edited abstract.

CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)
Bryce W. Anglin

Project Number
S0302

Project Title
Just Wing It: A Comparison of the Effect of Aspect Ratios and Surface Areas on Aerodynamic Moment

Abstract

Objectives/Goals
The objective is to compare wings varying in aspect ratios with a constant surface area and in surface areas with a constant aspect ratio to compare changes in aerodynamic moment from 0 degrees to 25 degrees angle of attack. My hypothesis is wings with larger surface areas will have a stronger aerodynamic moment and aspect ratio will not affect aerodynamic moment.

Methods/Materials
Eight styrofoam wings were constructed following the outline of the NACA 2512 airfoil. Five of the wings varied in aspect ratio with constant surface area, two of the wings varied in surface area with a constant aspect ratio, and one of the wings shared the constant aspect ratio and surface area. Wings were tested in a home-constructed wind tunnel. Wings were attached on the front of a lever connected with a hinge to an elevated pediment-like surface that utilized stoppers to keep the lever between 0 and 25 degrees inclination. A counterbalance of coins was placed on the other side of the lever. Each wing was attached to the lever, placed in the center of the wind tunnel, and tested three times. For each test, a stopwatch recorded the time starting with the start of the fan and ending with the lever hitting the stopper at 25 degrees.

Results
For varying aspect ratios, the worst moment produced ocurred at the aspect ratio of 5.4. The best moment produced ocurred at the aspect ratios of 7.1 and 1.8. As the aspect ratio increases, the aerodynamic moment sharply increases. As the aspect ratio decreases, the moment gradually increases. For varying surface areas, the largest surface area with 70.6 sq. inches produced the most moment. The surface area of 17.6 sq. inches produced the worst moment. As the surface area lessens, the aerodynamic moment decreases in force.

Conclusions/Discussion
The data refuted the hypothesis. Although the hypothesis was correct that wings with larger surface areas have stronger aerodynamic moment, aspect ratios play an important role in producing aerodynamic moment.

Summary Statement
My project was to compare variances in aspect ratios and surface areas of aircraft wings in terms of aerodynamic moment.

Help Received
Father helped construct wind tunnel and conduct testing; Mother helped design board.

CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)
Joshua M. Arreola

Project Number
S0303

Project Title
The Future of Clean Wind Technology: Designing the Most Efficient Bladeless Wind Turbine

Abstract

Objectives/Goals
The wind turbines of today, while somewhat environmentally friendly, have many key problems that make them inefficient and sometimes dangerous. My objective was to test Nikola Tesla's bladeless wind turbine design to determine if this turbine could surpass the Betz Limit of 59.3% efficiency and thus, create essentially a better and safer turbine for today's use.

Methods/Materials
I first researched the bladeless turbine's design and made it accordingly out of CD's and PVC piping. The traditional turbine was to act as the control of the experiment, and was created using Tinkertoys, PVC piping, and balsa wood blades. A wind tunnel was created to attain a controlled environment for the turbines, and the wind was created from a small box fan. Small DC motors were attached to each turbine to measure energy output in voltage and amperage. The wind power formula was then utilized in order to find the energy output of both turbines. Finally, these results were observed and compared to determine the more efficient wind turbine design.

Results
The results achieved from the experiment were somewhat inconclusive due to the lack of proper materials to conduct the experiment. While trying to test the Tesla Turbine, it wouldn't turn with the fan. In order to achieve results, I tested the bladeless turbine with an air compressor. Both turbines proved to be less than 1% efficient, with the bladeless turbine being slightly more efficient. However, these results cannot be recognized as significant due to such small efficiency percentages. In order to achieve accurate results, scale model turbines constructed from appropriate materials instead of household materials are needed.

Conclusions/Discussion
For this experiment, I have learned that using crude materials will not achieve any useable results. In order to determine if the Tesla Turbine will be able to operate at a higher efficiency than a traditional turbine, I have concluded that the next step is to use proper scale model apparatuses. This project has taught me to interpret problems like an engineer in order to find solutions. Not only does this experiment have the potential to produce a product that is energy efficient and safe for the environment, but it could also yield an entirely new outlook on clean wind technology.

Summary Statement
To determine if it was possible to design a bladeless wind turbine that would operate more efficiently than a traditional turbine and solve some of the problems that traditional wind turbines face today, e.g., bird killing and noisiness.

Help Received
Mom assisted with purchasing the materials and taking pictures. Dad advised on how to use certain tools in order to construct the turbines. I received mentoring from my Chemistry teacher, Mr. Barry Lindaman, and from my friends Mr. Bradford Oliver and Dr. Richard Chapleau.

Name(s)

Leonel Banuelos; Nicholas Ross

Project Number

S0304

Project Title

The Tubercle Effect: A Study of the Effect of Tubercles on the Wings of Planes on Flight Efficiency

Abstract

Objectives/Goals

This project was designed to test whether adding tubercles to the leading edge of wings on planes would allow it to travel farther while in flight. It is believed that the planes with bumpy tubercles will fly the farthest for both the sweptback and straight designs.

Methods/Materials

Materials: foam board (plane), rubber bands, pennies, paper clips, tape, a tape measure, a stopwatch, and a 20° slope launcher. There were two categories of wings: sweptback and straight, with three different wing types: Flat, Tubercle, and Spiky. The planes were tested with three different centers of gravity. The CG was moved forward/aft by taping pennies to the nose/tail of the plane. The planes were tested 10 times each with a new rubber band for each different plane trial. Testing proceeded by attaching a rubber band to a plane by a notch cut, pulling back to a preset point, and recording the flight time after launch. When it landed the distance was measured using the tape measure.

Results

(all calculations are done in units of feet)
Sweptback Wing/Straight Wing
Normal CG:
Flat Wing: avg. 21.85/11.30
Spiky Wing: avg. 21.58/11.31
Bumpy Wing: avg 19.40/11.49
Behind CG:
Flat Wing: avg. 8.37/8.85
Spiky Wing: avg. 9.17/7.61
Bumpy Wing: avg. 8.85/7.39
Forward CG:
Flat Wing: avg. 13.62/11.78
Spiky Wing: avg. 14.83/12.07
Bumpy Wing: avg. 14.36/9.59

Conclusions/Discussion

The data do not entirely support the hypothesis. In the straight wing category, the plane that flew the farthest was the Tubercle at normal CG and in the sweptback the smooth winged plane at normal CG flew the farthest. While the sweptback planes with the aft and forward CG did not fly as far, the tubercle design

Summary Statement

To test the efficacy of tubercles on the leading edge of wings on airplanes.

Help Received

Mrs. Banuelos for computer graphing assistance.

CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)

Kate B. Danker

Project Number

S0305

Project Title

The Power of Wind: A Wind Powered Electric Car

Abstract

Objectives/Goals

My objective is to discover if wind energy obtained from small wind turbines attached to an electric car can provide enough power to charge the battery of the car while driving.

Methods/Materials

Using an anemometer, I tested the wind velocity at eight different locations around a car driving at a steady rate. With my recorded data, I used the equation P=1/2pAV^3, to calculate the amount of power available at each wind velocity. I compared the total power available from eight small wind turbines to the power an electric car#s battery uses in driving.

Results

From my calculations, I found that eight small wind turbines can provide a substantial amount of power. For example, eight wind turbines with a diameter of four inches, driving at an average speed of 55 miles per hour, can provide 339.23 Watts of power, compared to the 240 Watt hour that the Nissan Leaf has.

Conclusions/Discussion

I cannot accurately state that the wind turbines can provide enough wind energy to power an electric car#s battery endlessly, because there are many factors that come into play. I did not calculate the drag created by the wind turbines, which would alter my results, because I did not have the resources. To obtain more specific results, I will need to test the actual electric car that will be powered by the wind turbines, and run physical tests with different wind turbines to find which material and shape of turbine is most effective and creates the least amount of drag. My calculations show general results that provide encouragement for further work.

Summary Statement

My project is on powering an electric car's battery with wind turbines.

Help Received

Father helped with experiment by driving; Father's work friend lent anemometer; Father helped operate Microsoft Excel

CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)
Petcharat Denprasert; Nathalie Rodriguez

Project Number
S0306

Project Title
Injectable Fetal Pacemaker

Abstract

Objectives/Goals
Build a fetal pacemaker for the hydrops fetalis condition, which has a 100% fatality rate, with prior microtechnology expertise in order to be injected into the fetal heart and keep it there to support the heart for one month. The technology that comes with the complete pacemaker can be used as a precedent for other injectable devices in order to make them less invasive and more reliable.

Methods/Materials
In the mechanical engineering issue, we used fruits such as mangos, potatoes, celery, Jell-O, and cucumbers to emulate fetal heart tissue. Using an electrode coil of iridium, we measured the amount of force needed to turn the electrode in 90 degrees using a pressure gauge to create a ratio. After setting the coil against the material at 0 N, we began to turn the electrode in and marked the degrees of turn it took to penetrate the surface. Using the ratio, we convert the force to Newtons to measure the ease of use for the device.
In the electrical engineering issue, we designed a circuit with the intention of having the 3V battery durability last one month, which will give physicians time to deliver the fetus, or for the fetus to correct its own heart rate. Another circuit is being designed to recharge the pacemaker while it is not in use in order to eliminate leakage of energy from the battery and extend storage life.

Results
In the mechanical experiment, we discovered that the large electrode was easier for physicians to use because it required fewer degrees of turns to penetrate the surface of the material.

In the electrical experiments, we discovered that due to the battery cell's rechargeable quality, the battery life was about 1/4th of that of a nonrechargeable cell. The circuit with a rechargeable cell would last about 6 days, and with a nonrechargeable, the circuit would last about 24 days. The recharge circuit works optimally and minimizes leakage of the lithium cell.

Conclusions/Discussion
Both mechanical and electrical components of the device closely meet the demands of the objective. The electrical designs can be changed to support a different normal heart rate. The mechanical designs of this project will initially be used for fetuses, but can be expanded for other life-saving devices.

Summary Statement
The development of a fetal pacemaker will save the lives of about 500 unborn children per year who otherwise have no cure and are subject to 100% fatality rate.

Help Received
Used lab equipment at University of Southern California under the supervision of Dr. Gerald Loeb

CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)

Rowyn D. Gilfillan

Project Number

S0307

Project Title

Flying Flowers Flaming Hairspray

Abstract

Objectives/Goals

My goal is to find what projectile will be launched furthest on average from two different cannons of different barrel lengths. I think that the longer barrel length will launch the heaviest projectiles further on average than any other projectile from either barrel length.

Methods/Materials

By adding the same amount of fuel to two different cannons and igniting it I launch the projectile forward, then measure after the launch had been done, by doing this 12 times for each projectile from each cannon I have hopefully gathered enough data to prove my hypothesis correct or incorrect.

Results

I found that the longer barrel length launched the lightest and medium weight projectiles furthest on average whereas the shorter barrel length launched the heaviest weight furthest on average.

Conclusions/Discussion

I found that the shorter barrel length ended up launching the heaviest projectile the furthest on average, and that the longer barrel launched the two lighter projectile furthest on average.

Summary Statement

My project is about different cannon barrel lengths and how they launch different weighed projectiles of the same dimension.

Help Received

Mother helped with board set up, step father helped watch launches.

Name(s)

Sang Yoon Han

Project Number

S0308

Project Title

The Near Infrared Reflectivity of Different Types of Roofing Materials

Abstract

Objectives/Goals

The purpose of this project was to find out the reflectivity of near infrared ray (NIR) of different types of roofing materials. The three roofing materials that were used in this experiment were wood shingles, galvanized iron shingles, and clay shingles.
It is believed that the clay shingles would have the most reflectivity of NIR because based on the preliminary background research; the clay had the most conductivity of both heat and electricity.

Methods/Materials

Experimentally measuring the reflectivity of the roofing materials involved taking pictures of the roofing materials at the same time with numerous trials under same condition with digital single reflex camera (DSLR) with a NIR filter in front of a lens. Then each picture was cropped with the same dimension that contains three distinctive roofing materials. The reflectivity of these roofing materials was measured by the color saturation of each cropped image. The color saturation of each image will be measured using software.

Results

Each cropped images were measured by ppi or pixels per inch. The lower the value of ppi means that the image is low in density. The lower the number of density of an image is the result of lighter image which proves that it has the high reflectivity of near-infrared radiations which has been shown in the RGB histogram.
The average ppi of clay shingle was 182 ppi whereas the ppi for galvanized iron shingle was 236.4 ppi with the highest ppi value and 215.5 ppi for wood shingle.
Since the ppi value for the clay shingles were the lowest with 182 ppi, this implies that the clay shingle reflected the most amount of NIR.

Conclusions/Discussion

It was found that the clay shingles had the least density of color which means that it reflected the most amount of near-infrared radiations. This could be concluded because when the density of an IR image is low; an image appeared as light compare to an image of high density of color based on the background research. This means the lighter image reflected more infrared radiation compare to the darker image. Thus, it was concluded that the clay shingles reflected the most NIR rays and wood shingles absorbed the most rays.

Summary Statement

My project was about finding the reflectivity of near infrared radiation of different types of roofing materials to see which material is most suitable for certain climate.

Help Received

Father helped gathering materials and setting up the project; My science teacher Mr. Antrim helped me to guide through the project and successfully finish it.

CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)

Gene Hoshino; Kenton Hoshino

Project Number

S0309

Project Title

My House Is 70°, What's Yours? A Study Comparing 4 House Exterior Sidings on Their Ability to Maintain Room Temperature

Abstract

Objectives/Goals

An experiment last year determined that a building#s exterior color made a notable difference in heat reflection and absorption, and in turn, the heating and cooling costs. If color can make such profound changes, then exterior sidings should make even more profound changes. This experiment was conducted to identify a siding that would be able to prevent a building#s interior from leaving room temperature quickly in simulated summer and winter conditions.

Methods/Materials

A wooden box 2x2x3 ft was constructed. Four sets of walls were built with separate siding material. The tested sidings were composed of concrete, clay, slate, and stucco. Two temperature tests were conducted on each set of walls. A set of remote thermometers were placed inside with the receivers placed outside. One of the siding sets were placed on the box. An infrared heat dish was facing the box, sending approximately 90°F of heat towards the box. When the interior temperature of the box exceeded the standard room temperature limit, the test was completed. Interior temperature was taken at two minute intervals to show the interior temperature#s reaction over time. The second test was done with the box being placed in an industrial freezer set at 35° F. The results were done by comparing temperature retention times.

Results

The heat tests indicate that sidings composed of clay and stone were far more effective than the stucco and the concrete sidings. Stucco ended at an average of 22.2 minutes. Concrete averaged 36.4 minutes with fairly consistent data. Slate averaged at 39.2 minutes. Clay tile lasted up to 50 minutes and an average of 49.8 minutes. During the cold test, it was noticed that all the tests times were much shorter. Concrete averaged 7.6 minutes and slate tile averaged 8.8 minutes. Adobe held the temperature for 18 minutes and an average of 11.4. This supports the findings of the heat tests.

Conclusions/Discussion

The objective of this project was reached. Through testing, two main factors determine a building#s material#s ability to retain room temperature. The first is the thermal mass of the object. The second is the reflective property of the object. If a strong combination is reached, then that material will have strong properties in retaining room temperature. Clay is the most effective as it has a high reflectivity and high thermal mass, making it able to retain room temperature the longest.

Summary Statement

This experiment was conducted to identify a siding that would be able to prevent a building#s interior from leaving room temperature quickly in simulated summer and winter conditions.

Help Received

Mr. Grubb helped provide research information, Mr. Frank Baird helped create box, Mr. Wayne Walter helped create box

Name(s)

Stacey A. Huang

Project Number

S0310

Project Title

Safety or Savings? Washout Designs on an Airplane Wing Considering Induced Drag

Abstract

Objectives/Goals

The purpose of this project was to discover whether there was an optimum amount of washout that could be incorporated in an airplane wing, in which the stability and safety benefits are applicable while the accompanying induced drag is at a minimum value.

Methods/Materials

The effect of geometric twist (washout) was tested with regard to the point of flow separation along the wingspan and the coefficient of drag. 5 physical wings with +3, 0, -3, -6, and -9 degree washout were fashioned and tested individually in a water tunnel. Flow modeling was achieved using dye injection at the trailing edge of the wings, and aerial photos were taken of the wings at different angles of attack. Subsequently the computer program LinAir was employed to reproduce the modeled wings with geometric twist ranging from +16 degree washout to -16 degrees. For every wing the angle of attack at which the lift coefficient equaled 0.50 was used to calculate the corresponding drag coefficient for each wing.

Results

The implemented washout designs, as demonstrated by the flow visualization patterns in the wind tunnel, moved the point of flow separation inboard. However, the LinAir modeling showed that while the stall region move closer to the wing root, the coefficient of drag reached a minimum at -1 degrees of washout and began to steadily increase with both increased and decreased washout. The angle of attack at which each wing reached a lift coefficient of 0.50 increased as the amount of implemented washout increased.

Conclusions/Discussion

It may be beneficial to increase washout in order to gain the stability benefits since the amount increase in the coefficient of drag negligible. However, as demonstrated by the LinAir experimentation, with the addition of washout the wing begins to have a negative lift coefficient and effectively lifts downwards at small angles of attack, which slowly increases as the amount of washout is increased. In addition, the lift coefficient is significantly less for those wings with washout as opposed to those which twist in the opposite direction. Therefore, the question of whether to implement washout may simply be the choice between paying more for a safer, more stable airplane ride and paying less for a more efficient and faster ride.

Summary Statement

My project aimed to discover whether there was an optimum amount of washout that could be incorporated in a wing in which the wing is both stable and safe but the induced drag is at a minimum.

Help Received

NASA engineers provided computer program, assisted in creating wing models, operating water tunnel

Name(s)

Tyler R.Z. Johnson

Project Number

S0311

Project Title

Shaping Flight

Abstract

Objectives/Goals

My project goal was to determine if the angle of a plane's wings have a direct effect on the average speed of the plane. I believe that a plane with wings angled closer to the body will have a greater speed.

Methods/Materials

Three paper airplanes were made, as well as a launcher to achieve controlled takeoff rate, a timer and measuring tape were also used. One airplane was made with average wing angle, and was used as a control. The other two had an extremely obtuse angle, and an extremely acute angle. The planes were tested at a controlled indoor area, four times for accuracy.

Results

The plane with the acute (close to the body) wings had a consistent higher speed than the others. The obtuse plane flew farther, slower. The average plane was between the others.

Conclusions/Discussion

After experimentation, my hypothesis was proven correct, and my objective reached. The plane with acute wings flew the fastest of the three in every test performed. This project helped my to better understand how an airplane attains lift and thrust based on air movement around the wings.I feel I understand this topic very well, and I am glad to have this experience for later years of my life.

Summary Statement

My project is about the effect of wing shape on the speed of an airplane.

Help Received

Principle helped attain supplies and organize project; Father helped wire launcher; Sister supplied spray paint for board.

CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)

Kalen Kasraie; Conley Schroepfer

Project Number

S0312

Project Title

Alternative Construction

Abstract

Objectives/Goals

Our objective was to determine which green building materials perform the best compared to standard-fiberglass insulation materials when exposed to extreme hot and cold temperatures. We tested Adobe Brick, Cordwood, Earthships, Rammed Earth, Straw Bale, and Fiberglass Insulation.

Methods/Materials

We built a test box and formed walls made out of adobe brick, cordwood, earthships, rammed earth, straw bale, and fiberglass. During a predetermined time period, we exposed one side of each wall propped up inside the box to extreme hot and cold temperatures and measured the changes in temperature on the opposite side of the wall within the test box. We recorded the temperatures on both sides of the test walls.

Results

Based on our test results, cordwood performed the best and straw bale performed the worst compared to standard-fiberglass insulation materials.

Conclusions/Discussion

Our hypothesis was incorrect, because we suggested adobe brick would withstand the elements the best, but cordwood did the best overall. We discovered that in order to build a substantial building out of any of these alternative materials, extensive time and labor are required, as well as various different materials. Further testing on these sample walls may include susceptibility to seismic activity, water damage, and high winds simulating a tornado. A comparison of the weight and cost of using such alternative building materials would also be extremely valuable information for future alternative builders.

Summary Statement

We tested which green building material insulates the best compared to the current industry standard-fiberglass insulation when exposed to extreme hot and cold temperatures.

Help Received

My brother, Casey Schroepfer, helped us build the test box.

CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)

Laura Leyva; Joana Perdomo; Angelica Saavedra

Project Number

S0313

Project Title

RC Surveillance Vehicle

Abstract

Objectives/Goals

Our objective was to design and build a helium-filled RC blimp that could carry a payload of a minimum of two pounds and record a clear video.

Methods/Materials

To enhance speed and endurance we chose to use Mylar for the blimp material because it is light weight and inexpensive. Through testing, an ellipsoid proved to be the best shape in comparison to a cube and sphere because of its aerodynamic qualities and maneuverability. In order to control the blimp, we used two ducted fans, three servo motors, three batteries, two speed controllers, a wireless video camera, and the receiver for the remote control. We programmed the six channel remote control to operate the electronics. All the electronics were stored in a Styrofoam gondola. To view the images from the camera, a receiver is connected to a television.

Results

We performed a wind tunnel experiment to test which shape (cube, sphere, ellipsoid) was the most aerodynamic. After concluding that an ellipsoid was the best choice we began to construct our blimp. Through trial and error, our group made several significant findings. One of the significant findings we made was that tape is a better sealant than glue because it prevented helium from escaping the blimp and was easier to use. We also found that we had to consider the total voltage and current that the electronics could resist. We took into account the power of the motors to make sure it gave the blimp enough thrust to fly. This all contributed to the completion of the airship.

Conclusions/Discussion

The final product is an RC airship that can record a video 30 ft. away from the receiver and that can fly 250 ft. away from the remote control. The ship and camera can be maneuvered to turn left, right, up and down and the ship can sustain the helium for 2-4 hours. With further research and development, this project can be scaled up to a something professional engineers could work on to create a similar blimp. This would allow them to aid in reconstructing areas that have been destroyed.

Summary Statement

We designed and built a helium-filled RC surveillance airship that could aid in a disaster relief zone.

Help Received

Used lab equipment at school under the supervision of Mr. Rivas; Ms. Lee, Pre-calculus teacher, tried to help with the equations.

CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)

Bolun Liu

Project Number

S0314

Project Title

An Innovative Predictive Model of Catapult Performance

Abstract

Objectives/Goals

We examine the consequences of using mathematical and statistical modeling to characterize the functional performance of a novel catapult design. Real-world projects are complex and runs are costly. Our project explores fractional factorial experimental design to characterize a mechanisms performance. The design allows for testing of multiple factors at an acceptable number of runs.

Methods/Materials

The novel mechanism is a catapult with a range of up to 4 m. We will: 1. build a novel catapult that produces reliable, predictive functional performance; 2. run a fractional factorial design of size 2^(5-1) (resolution IV); 3. create mathematical and statistical models to predict functional performance. We will compare the catapult performance of a theoretical model to the predictive capability of fitted statistical model. The catapult will be subjected to tests using a semi-randomized experimental design with 20 runs (2^(5-1) + 4 centerpoints), and five three-level factors. The response effects for factor settings will be assessed by comparing responses at high- and low-level settings. The most significant effects for given factor settings will be used to construct a multiple regression model. The predictive capacity of the fitted regression model will then be tested. The theoretical model will be compared to the statistical model.

Results

Projectile launched towards 1 m, 2 m, 3 m had average values of 1.09 m, 2.01 m, and 3.08 m, respectively. Shot distributions were approximately normal distributed in agreement with our models. We verified the goal of building a novel, precise, mechanical apparatus, since all factor effects were clearly distinguishable from random noise. Additional predictive tests of the fitted model exhibited performance at a 95% confidence level. The catapult was not equally capable at all targets; however, resulting impacts fell within the hypothesized 0.15 m range of the intended target. This is a remarkable level of predictive capability.

Conclusions/Discussion

The goals of the project were fully attained. More advanced studies of catapult performance could be done: 1. we could investigate quadratic effects in the experimental design; and 2. we could use advanced multiple regression analysis, such iterative multiple regression analysis (IMRA).

Summary Statement

Statistical experimental design complemented by multiple regression analysis allows for the characterization of functional performance of a complex mechanism.

Help Received

Dr. John C. Howe, Dr. Charles Barker, and Bowei Liu were mentors. Encouragement from my parents.

CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)

Patrick A. Lowe

Project Number

S0315

Project Title

Comparison of Fanwing Configuration Efficiency: Year II

Abstract

Objectives/Goals

This project was designed to continue research to find the best ducting configurations for a fanwing propulsion system in respect to its efficiency in lift and thrust. A fanwing works on Bernoulli#s principle which states that the velocity of a flow varies directly with its pressure. The fanwing embeds a squirrel cage fan along the leading edge of the wing. This enables it to take in a larger amount of air and therefore is more efficient. The fanwing system takes in air from the leading edge, accelerates it, and then expels it over the trailing edge, which creates lift. Ducting has been used to make existing propulsion systems more efficient. If designed incorrectly, however, ducting can be detrimental to a system. No one has applied ducting to fanwings to increase efficiency. In year I of this project, the feasibility ducting was confirmed. Year II of this project focused on finding the optimal ducting configuration to increase both lift and thrust.

Methods/Materials

A new wing was designed with lighter drive system, reducing weight by 50%. The functioning fanwing was tested in a subsonic wind tunnel. The fanwing was designed to fit into the cross section so that wing tip vortexes would not be a factor. The fanwing was tested in over 30 different configurations each with different ducting shapes, positions, and drive systems. Each was tested 12 times for lift and thrust. The inherent lift and drag of all configurations was measured and factored out of the raw data. Additionally, smoke tests were performed to gather qualitative data that revealed trends behind successful designs. All data was compared to the control of a ductless wing.

Results

The average lift of configuration C'5 at 2.25 was the greatest at 153.1 grams resulting in a 20% improvement over that of the control at 129.5 grams of lift. In addition, the average thrust of C'5 at 2.25 was the greatest with 21.6 grams resulting in a 100% improvement over that of the control at 11.7 grams of thrust.

Conclusions/Discussion

The data gathered shows that configuration C'5 at 2.25 was the best all-around. Even though C'5 at 2.25 was found to be the best out of all tested configurations, research is not over. Dynamic ducting, genetic programing, larger models, and other modifications could reveal better designs. This experiment, however, has determined trends that lead to efficient ducting and further reinforces the promise of efficiency through ducting.

Summary Statement

I designed ducting to improve the efficiency of the fanwing system by 20% in the amount of lift generated and 100% in the amount of thrust produced.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)

Russyan Mark S. Mabeza

Project Number

S0316

Project Title

Utilizing Corn Cobs, Carton Boxes, and Plastic in the Production of Particle Boards

Abstract

Objectives/Goals

The goal of this project is to create a particle board out of corn cobs, carton boxes and plastic and to see the quality of each particle board depending on the ratios of the materials. In doing so, the project will help towards alleviating problems with pollution, since materials used are waste products. It will also provide an alternative construction material, aside from the conventional wood products.

Methods/Materials

Corn cobs were manually hammered into smaller particles. Carton boxes were cut with a paper shredder, and plastic bags were cut manually with scissors into smaller strips. The materials were mixed according to their ratios (2:1:1, 1:2:1, 1:1:2) along with 453 g of resin and compressed in a mold made out of two metal plates and a 13.5in x 13.5in frame. The materials were then heated up in the oven for a total of 14 minutes and cooled down overnight. The upper metal plate was then removed and the particle boards were allowed to set for 10 more hours.

2in x 2in specimens were cut for all the treatments and tested in terms of water absorption, thickness swelling and flammability.

Results

Treatment C (1:1:2, or predominantly plastic) outperformed the others in terms of water absorption and thickness swelling. Treatment B (1:2:1, predominantly carton boxes) outperformed the others in the flammability test.

Conclusions/Discussion

With these results, we can see that corn cobs, carton boxes and plastic can indeed be used as components for particle board. There is also a significant difference among the treatments in terms of water absorption, thickness swelling and flammability with Treatment C outperforming the others in two out of the three tests. While these particle boards are prototypes, they exhibit a lot of promise for further testing in terms of mechanical properties such as modulus of rupture and tensile strength.

Summary Statement

Through this project, we find that corn cobs, carton boxes and plastic can be used as components for particle board, opening up possibilities to help alleviate pollution and provide alternative building materials,

Help Received

Mother helped cut boards and time flammability; Friends helped cut plastic and carton boxes; Mold (metal plates and frame) were produced from a welding shop; Received $500 grant from UC San Diego California State Summer School for Mathematics and Science; Received suggestion from UCSD faculty

CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)

Matthew G. Morris, III

Project Number

S0317

Project Title

Comparing Hydrodynamic Lift against Lead Ballast in Sailboat Performance

Abstract

Objectives/Goals

Equivalent sailboats using the proposed keel design producing hydrodynamic force to generate righting moment will outperform sailboats using conventional moveable lead ballast systems, both upwind and downwind.

Methods/Materials

Build a model with the two subject, canting and hydrodynamic keel configurations; using an open flow bench, monitor flow rate and measure the drag and the righting moments generated by each keel configuration for upwind and downwind sailing. Compare the mean force and drag when the model is configured for sailing upwind for both types of keel. Measure and compare the drag for each keel type with the model configured for sailing downwind.

Results

The results show that the hydrodynamic keel concept out performs the ballasted canting keel both upwind and downwind. Sailing up wind, the force (lift) to drag coefficient for the hydro keel is .3160 as opposed to .2889 for the canting keel. Test results also show a significant reduction in drag when comparing the relative performance of the downwind configurations. Mean net drag for the hydrodynamic keel downwind, was measured to be .0228 compared to .0913 Newtons for the canting keel.

Conclusions/Discussion

The hydrodynamic lifting keel concept may offer significant advantages in safety and performance over the ballasted canting keel. Preliminary analysis also supports significant reductions in structural loads and torque requirements. More detailed analysis and testing is required to refine the design concept and exploit any potential performance and safety benefits.

Summary Statement

Analysis and test results support that the proposed keel design significantly reduces structural loads, actuation torque requirements and overall weight, while improving performance and safety on any point of sail or sea condition.

Help Received

Materials furnished by Probiuld, OB Hardware and Schilling 3-d; display board provided by neighbor; lab equipment supplied by Point Loma HS; nieghbor helped with remote control test model.

CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)

Loren J. Newton

Project Number

S0318

Project Title

Forces on the Road: Are You Inclined to Bank on a Curve?

Abstract

Objectives/Goals

My objective is to investigate how the bank, incline, and curve angle on a roadway affect how easily and safely a vehicle navigates through the curve.
I set my goal to visualize my analysis (since I did not come across any references of such during the course of my research) of the combined effects of inclines, banks, and curves on the forces of work in motion.

Methods/Materials

PART 1: Construct a model roadway and record the time taken for the R/C vehicle to travel, at a constant speed, the same curve but with different combination settings of 9 incline angles and 9 bank angles.
PART 2: Derive from Vectors Diagram and 3D Vectors Model to realize the the resultant force (by the various combination of incline and bank angles) that the driving force (by the vehicle) was altered and needed to overcome.

Results

In general, it took a shorter time to travel the curve with a decreasing incline, increased bank into the curve and vice versa with an increasing incline. The same pattern of results held for both wider and narrower curve. From the 3D Vectors Model, the formula for the magnitude of the resultant force and the angle that the driving force had been swayed was derived.

Conclusions/Discussion

My test results agreed with my vectors analysis.
The driving force on the road is altered by the act of the gravitational force on inclines and banks of the road. A wider curve and larger bank into the curve is more efficient for driving in roadway design, but more control is needed by the driver during a declining path.

Summary Statement

To investigate and analyze the effect of incline and bank angles in negotiating a curve.

Help Received

My dad helped shop for material and supervised use of power tools during construction. My mom helped with the display board.

Name(s)

Ryan O. O'Connor

Project Number

S0319

Project Title

The Effect of Golf Club Lofts on a Golf Ball's Trajectory

Abstract

Objectives/Goals

These experiments were completed to test which club head angle performed the best, resulting in a better trajectory and farther distance. The club head of a golf club is the bottom part, making contact with the ball at impact. When hitting a golf ball, to achieve maximum performance, low spin and a boring ball flight. Flight path of a golf ball is determined by the speed and direction the golfer swings the golf club at impact. If the club head is square to the target at impact, the ball will go generally straight.

Methods/Materials

The experiment was conducted at Rodger Dunn Golf Shop. The launch monitor computers generate a picture of the trajectory and statistics of the golf ball when hit. The procedures were to hit five balls with each: 8.5 degree Titleist Driver, 9.5 degree Titleist Driver, and a 10.5 degree Titleist Driver. The control was the club in the middle with the average club head loft, 9.5 degree Titleist Driver. The data was averaged and studied after the tests were done.

Results

The Titleist 8.5 Driver traveled an average total distance of 242m, the Titleist 9.5 Driver traveled a total distance average of 230m, and the Titleist 10.5 Driver traveled with an average total distance of 237m. The Titleist 8.5 Driver had a peak height average of 43m, the Titleist 9.5 Driver had an average peak height of 42m, and the Titleist 10.5 Driver had a peak height average of 45m. Overall, the Titleist 8.5 Driver traveled farther and had a low peak height. In second, the Titleist 10.5 Driver traveled with a higher peak height, yet it had a farther average distance. The Titleist 9.5 Driver had the lowest peak height average, but didn#t come out with the farther distance.

Conclusions/Discussion

Looking at the overall statistics of the experiment, The Titleist 8.5 Driver had the best results with a long hit of about 255m. The control, Titleist 9.5 Driver, had solid results with a total distance average of about 230m. The 10.5 Titleist Driver had just a little better result on distance than the 9.5 Titleist Driver. Although, the 10.5 Titleist Driver traveled the highest, giving up some of its distance up, instead of out and farther.

Summary Statement

The overall goal in this project was to obtain the optimum golf club driver degree of loft that produced the best results, meaning the farthest distance.

Help Received

The project was conducted at a local golf store, Rodger Dunn Golf Shop, where they allowed me to use ball tracking equipment and software to receive me data.

CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)

Caitlin A. Redak

Project Number

S0320

Project Title

Black Widows vs. Orb Weavers: Extracting the Difference

Abstract

Objectives/Goals

My goal was to determine if orb weaver spider webs are stronger, with a higher tensile strength and breaking strength, than black widow spider webs. Because orb weavers build webs that are in the open air, their webs need to withstand more force to catch flying prey, than black widow webs which are built close to the ground in secluded areas to catch walking or crawling prey.

Methods/Materials

I extracted silk from six black widows and three orb weavers and then paced that silk on a hand-made, card stock slide with one of three determined lengths to measure breaking strength. Lightweight washers were placed on the silk until it broke and the mass required to break the silks was calculated to find breaking strength in g/cm. More silk was then extracted, placed under a high-powered microscope, and imaged to determine the diameter of a cross section of silk. The area was then calculated and used in combination with the mass required for breaking strength to find the silk tensile strength in N/mm^2.

Results

I found that breaking strength of both species' silk was stronger in shorter silks than in longer silks, however, there was no statistical difference between the average breaking strength of the two species. I found that the diameter of silk increased as spider mass increased for both species and that the diameter was slightly larger in black widows. I found no relationship between tensile strength and the length of the silk suggesting tensile strength is a physical property of the silk regardless of length. Finally, because orb weavers have a slightly smaller diameter silk, their silk has a higher tensile strength than the silk of black widows.

Conclusions/Discussion

I could not accept my hypothesis that breaking strength was higher in orb weavers than black widows because they were not statistically different for a given length. I did accept my hypothesis that orb weavers had a higher tensile strength than black widows. With this result about tensile strength, I concluded that tensile strength, being a measure of how much a material can stretch without breaking, or elasticity in general, is a substitute for stability.

Summary Statement

My project compared the breaking strength and tensile strength of black widow spider and orb weaver spider silks to determine if one was stronger than the other.

Help Received

Mr. Tom Prentice, Dr. Richard Redak, Ms. Breanna Harris, and Dr. Kimberly Hammond helped with the collection of spiders; Dr. Richard Cardullo instructed on the use of Zeiss Axiovert 10 Inverted Phase Microscope; Dr. Kimberly Hammond provided lab space at UCR and was consulted.

CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)
Josephine Wong

Project Number
S0321

Project Title
Power of the Waterwheel

Abstract

Objectives/Goals
The objective is to develop a formula that relates the number of blades to the time it takes my waterwheel to lift a 16.4-gram object thirty-five inches.

Methods/Materials
I conducted three experiments. In Experiment #1, I used a three-bladed waterwheel, a six-bladed waterwheel, and a twelve-bladed waterwheel and controlled the weight at 1030.156 grams. In Experiment #2, I changed the weight of the waterwheel to 1030.156 grams, 1127.486 grams, and 1226.816 grams and controlled the number of blades at twelve. In Experiment #3, I used a 12-bladed waterwheel weighing 1030.156 grams, a 6-bladed waterwheel weighing 923.366 grams, and a 3-bladed waterwheel weighing 869.946 grams. I conducted five trials for each waterwheel. In each, I measured the number of seconds it took the waterwheel to lift the 16.4-gram object. I used the results from Experiments #1 and #2 to write my formula and the results from Experiment #3 to check whether my formula was correct.

Results
In Experiment #3, the twelve-bladed waterwheel took 13:27, the six-bladed waterwheel took 13:94, and the three-bladed waterwheel took 16:62 to lift the 16.4-gram object.

Conclusions/Discussion
These data results show that my hypothesis - when the number of blades is doubled, the time it takes waterwheel to lift the 16.4-gram object will decrease by 20% - was incorrect. The time actually decreases exponentially according to: $y = 23.01 \times 0.9501^x$, where x is the number of blades and y is the time elapsed in seconds. In the future, I plan to experiment how blade designs affect a waterwheel's efficiency.

Summary Statement
My project focuses on how the number of blades affects the time it takes the waterwheel to lift a 16.4-gram object thirty-five inches.

Help Received
Father helped me buy the materials needed to build the waterhwheel.

CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)
James Xue

Project Number
S0322

Project Title

Feasibility of Recycling Scrapped Tires and Silica Fume into Super-Duper Concrete

Abstract

Objectives/Goals

The objective is to evaluate the dynamic properties of the proposed rubberized silica fume concrete, which includes the damping ratio, seismic response, compressive strength, and Young's modulus.

Methods/Materials

Material for preparing normal, rubberized silica fume concrete specimen includes cement, sand, 10 mesh recycled rubber crumbs, 5 mm diameter steel bars, silica fume, and tap water. Experiments on compressive strength and deformation, free vibration, shaking table tests, and ductility of rubberized concrete structural samples were conducted.

Results

The results show that the average damping ratio of the rubberized concrete columns is 7.7 compared with 4.7 for the normal concrete columns. The peak response acceleration of the rubberized concrete columns in shaking table tests is 26% less than those of the normal concrete columns. However, the rubberized concrete dropped as many as 57% of the compressive strength for the 20% rubber replacement specimen. Introducing silica fume on the aggregate's surface is an effective way to improve interface bondings. Results from the rubberized silica fume concrete show the significant improvement in the compressive strength and Young's module of elasticity.

Conclusions/Discussion

The rubberized concrete structure suffers less seismic force than a normal concrete structure. This is because rubber can absorb the kinetic energy caused by the earthquake and transfer it into thermal energy. At the same time, coating the crumb rubber with silica fume will improve the bonding between crumb rubber and cement. This will mitigate the side effect of a decrease in compressive strength. In conclusion, the proposed rubberized silica fume concrete is promising. As a new construction material, it has its niche because of the superior performance in absorbing kinetic energy. Furthermore, the super-duper rubberized silica fume concrete is a future green material.

Summary Statement

Proposed rubberized silica fume concrete is feasible for a new type of green construction material

Help Received

Used lab equipment at UC Irvine with helps from lab technical assistants

CALIFORNIA STATE SCIENCE FAIR
2011 PROJECT SUMMARY

Name(s)

Ali M. Youssef

Project Number

S0323

Project Title

Strongest Truss Bridge

Abstract

Objectives/Goals

The purpose of this project is to investigate the load carrying capacity of different type of truss bridges. I knew I wanted to attempt this investigation one year ago. The idea came to me at the County Science Fair Competition last year where I built 3 types of bridges Suspended, Truss, and Beam. After that I focused on trying to figure out which type of truss bridge will be the strongest, Equilateral, Right Isosceles, and 30-60-90 deg. I chose to focus more on truss bridges because it is more practical and economical to build.

Methods/Materials

To perform this investigation, three types of truss bridges were built (three of each to get an average). These types are: Equilateral, Right Isosceles, and 30-60-90 deg.

The bridges were built using Balsa wood, Popsicle sticks, and tacky glue. Once the bridges were built and were dry enough to be tested, the Equilateral truss bridges were loaded first. The bridges were supported on each side by metal stools, and we hung a bucket from the center of the bridge and filled it up with water. I added water gradually to the bucket until the bridge broke. Once the results were recorded, the same test was performed on the Right Isosceles truss bridge as well as the 30-60-90 deg truss bridge. The same tests were performed two more times on each type of bridge, and the results averaged and recorded.

Results

The average weight held by the 90 deg. isosceles bridge was 7.56 kg with maximum deflection of . The equilateral truss bridge held an average weight of 17.56 kg, and the 30-60-90 deg. bridge held the maximum load of 20.56 kg.

Conclusions/Discussion

The results of this experiment proved that the hypothesis that the 30-60-90 deg. truss bridge holds the most weight was correct. The maximum load carried was 20.56 kg with maximum deflection of 2.31 inches. The 90 deg. Isosceles Bridge was the weakest type holding the least amount of load of 7.56 kg, with a maximum deflection of 0.56 inches. The equilateral truss bridge was the second strongest of all three bridges tested carrying 20.56 kg, with a maximum deflection of 1.3 inches. The reason the 30-60-90 deg. Bridge held the most weight is that the truss members were much more than the other two bridges, and therefore were able to carry more load.

Summary Statement

My project is about the testing of 3 truss bridges. Equilateral, 30-60-90 deg, and Right isosceles. Which is strongest?

Help Received

My Father instructed me through the building of the bridges.