CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)

Amanda M. Allen

Project Number

J1801

Project Title

Shake, Rattle, and Roll

Abstract

Objectives/Goals

In Shake, Rattle, and Roll, I tested three different shaped structures: a tower, a rectangle, and a pyramid, to answer the scientific question: Which shaped structure can survive an earthquake the best? I hypothesized that the pyramid would have the least structural damage.

Methods/Materials

I built the structures the same height using all the same materials. To make the models react more like a real building, I added a vertical load weight to each structure. I built a shake table to test my structures. For each trial, I shook each structure thirty seconds at a mild, moderate, and severe quake level. During each ninety second trial, observations were noted. Three trials were completed.

Results

The tower and the rectangle swayed during a mild quake and had structural damage after stronger quakes. The pyramid did not sway or tilt during any of the trials.

Conclusions/Discussion

I conclude that my hypothesis was correct and the pyramid structure survived the earthquakes the best. The pyramid structure's wide base and less vertical load on the upper floors was effective against the shaking of the quakes.

Summary Statement

My project is about how different shaped buildings react during an earthquake.

Help Received

Dad worked the power saw and drill; Mom watched the clock, noted by observations, and took pictures.

Name(s)

Matthew J. Armstrong

Project Number

J1802

Project Title

How Much Weight Can That Bridge Take? The Impact of Structural Support Elements on the Strength of a Bridge

Abstract

Objectives/Goals

The objective for this experiment is to find out which bridge, an arch, beam, or truss bridge, will support the most weight. The hypothesis for this experiment is that the truss bridge will support the most weight.

Methods/Materials

To perform this experiment, a total of two bridges for each bridge type (an arch, beam, and truss bridge) were built using popsicle sticks and a hot glue gun. Once the bridges were built, the beam bridge was tested first. The bridge was supported on each end by three bricks and a container was placed in the center of the bridge. Pre- measured lead weights were then put in the container one by one until the bridge broke. Once the results were recorded, the same test was performed on the arch bridge and the truss bridge. Each bridge was then tested again. Therefore, every bridge type was tested a total of two times and the results were recorded.

Results

The first beam bridge held 14.5 pounds. Beam bridge number two held 12 pounds so the average weight of the beam bridges was 13.25 pounds. Arch bridge number one held 21.5 pounds. The second arch bridge held 21 pounds so the average weight held by the arch bridges was 21.25 pounds. Truss bridge number one held 24 pounds. The second truss bridge held 23 pounds so the average weight held by the truss bridges was 23.5 pounds.

Conclusions/Discussion

The results of this experiment proved that the hypothesis was correct in that the truss bridge held the most weight. The beam bridge was the weakest holding the least amount of weight and the arch bridge was the second strongest bridge. The reason why the truss bridge is able to bear more weight is because it relies on compression and tension whereas arch bridges rely on mostly compression and beam bridges rely on mostly tension. The results from all of the experiments were consistent supporting the hypothesis although on most of the test bridges, some glue joints failed in addition to some of the wood breaking so wood glue rather than hot glue may give better results. In conclusion, beam bridges are useful for simple things like crossing a river because they are simple to build but truss bridges are most useful for heavy loads like railroads.

Summary Statement

This project is to find out which bridge, an arch, beam, or truss bridge, can support the most weight.

Help Received

Dad helped biuld the bridges and helped test them.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)

Lauren T. Aycock

Project Number

J1803

Project Title

London Bridge Is Falling Down

Abstract

Objectives/Goals

To design a truss structure based on equilateral, scalene, and isosceles triangles to determine the strength and the architectural benfits of the different triangles.

Methods/Materials

To test my hypothesis, I first had to build the nine trusses that consisted of three trusses based on equilateral triangles, another three based on isosceles triangles, and another three on scalene triangles. To build these trusses I had to build the truss sides and then connect it to another truss side with three base popsicle sticks and two popsicle sticks on top. I also made the control group from two overlapping popsicle sticks glued together. When the trusses were finished I then conducted the experiment. To do this I had to take two level supports set the trusses on it one at a time and tie two pieces of nylon line on the middle joint of both truss sides. Then I began gradually adding 250 ml to 1,000 ml of H2O until the truss hit its fullest weight capacity and broke. I did the above for each of the nine trusses and then analyzed the results.

Results

The trials below consist of 2 trusses so that the structure could stand upright. Altogether I constructed and tested 27 trusses. Below are the results of each set of 2 trusses. ex:scalene trusses trial # 1 held 9,000 ml of water.

Control Group Scalene Trusses Equilateral Trusses Isosceles Trusses ml H20 ml H20 ml H20 ml H20

Trial 1 1,000 Trial 1 9,000 Trial 1 16,000 Trial 1 14,000
Trial 2 3,797 Trial 2 11,336 Trial 2 15,625 Trial 2 9,647
Trial 3 5,000 Trial 3 6,000 Trial 3 12,000 Trial 3 13,253
Avg 3265.67 Avg 8778.67 Avg 14541.67 Avg 12300.00

Conclusions/Discussion

From the results I concluded that the truss based on equilateral triangles can support the least amount of weight (not including the control group). I can also conclude that the isosceles truss can support the most amount of weight. I could list the reasons but I don't have enough room.

Summary Statement

Which type of triangle supports the truss with the most benificial results.

Help Received

mom helped me tie the trusses;Dad helped me type

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)

Conor P. Beck

Project Number

J1804

Project Title

The Effect of Bridge Design on Bridge Weight Bearing Capacity

Abstract

Objectives/Goals

This project tested to see whether a Pratt truss or a Warren truss would hold more weight. The researcher's hypothesis was that the Pratt truss would hold more weight.

Methods/Materials

In this experiment, the researcher built both types of trusses out of popsicle sticks. Each one was placed, one at a time, in a testing device made of plexiglass and wood. Iron weights were then placed into a bucket that was attached to the bottom of the truss. Sand was slowly poured into the bucket until the truss failed. The project contained 50 total trials, 25 trials for each truss.

Results

The results of these trials showed that the Warren truss held an average weight of 35.16 kilograms, while the Pratt truss only held an average weight of 32.03 kilograms. The range of weight held by the Warren truss was 35.35 kilograms. High and low outliers were detected in these results, however, with a maximum weight of 50.85 kilograms and a minimum weight of 15.5 kilograms. For the 25 Pratt truss trials, the range of weights held was 14.63 kilograms with no outliers detected.

Conclusions/Discussion

The findings did not support the researcher's prediction. Where the Warren truss held more weight on average, the Pratt truss was more consistent. In the real world, engineers could use these findings to determine which truss design to use when building a bridge.

Summary Statement

This project tested to see whether the design of a bridge had an effect on the amount of weight the bridge could hold.

Help Received

Dad hepled with troubleshooting and testing; Mom helped type and proofread report; Teacher let me borrow the triple beam balance for testing; Neighbor provided Caltrans information on trusses and bridges.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)

Alexa Canova-Parker

Project Number

J1805

Project Title

Mussel Bound

Abstract

Objectives/Goals

To determine whether the addition of a form of Dopa (Nordihydroguaiaretic acid or NDGA) to man-made protein based glue (Elmers white) creates a stronger bond in both wet and dry conditions.

Methods/Materials

1. I obtained quantities of Elmers glue and a form of Dopa. I acquired the form of Dopa from Dr. Herbert Waite of UCSB, who is researching the protein make-up of mussel adhesive
2. I purchased popsicle sticks at the craft store and prepared them.
3. I kept all variables except the differences in the glue the same. The sticks glued with Elmers glue were my control group. I glued these first. The first set of my control group was the dry popsicle sticks. The second set of my control group was wet popsicle sticks.
4. The sticks glued with Elmers glue enhanced with Dopa (I will call that Dopa Glue) were my experimental group. I repeated the exact same procedures using Dopa Glue instead of Elmers glue in both the dry and wet environments.
5. Next, I tested how effective the Elmers glue and the Dopa Glue were in the different environments.
6. To ensure accurate results, I repeated this cycle four more times (five times total) and averaged the results of each group.
7. By analyzing the results shown on the data chart, I was able to determine that my hypothesis was not correct.

Results

As tested by my experiment, my hypothesis was clearly wrong. The covalent bond I anticipated would be created by the addition of Dopa was not formed (Waite, Mussel Adhesion, 312). However, experimental science is a process, not an outcome. The analysis as to why the experiment failed is the next step in discussing the results. Many unanticipated variables could have affected the outcome.

o First, is Elmers compatible with NDGA?
o Second, does the chemical structure of wood prevent the formation of a covalent bond using Dopa.
o Next, was NDGA the best substitute for Dopa proteins? (Waite, February 15, 1). The NDGA proteins are not exactly the same as the Dopa found in mussel proteins.

Conclusions/Discussion

Since my hypothesis, as tested, was rejected, I can vary the experiment. I would use an epoxy instead of Elmers; I would consider using glass, metal, or even mussel shell pieces for the surface; and I would change the Dopa equivalent, using another organic compound or catechol containing Dopa peptides.

Summary Statement

My project explored the contribution of Dopa to man-made adhesives, applying lessons learned from natural mussel adhesives.

Help Received

Dr. Herbert Waite, professor U.C.S.B., supplied me with the NGDA and ethanol.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
Enoch Chang

Project Number
J1806

Project Title
Bridge by Brick: The Relationship Between Contact Surface Area and Strength

Abstract

Objectives/Goals
The purpose of my project was to test why using rebar in reinforced concrete is staggered for freeway bridge construction and if contact surface area affects bridge strength. My hypothesis was that the greater surface area of contact on each Lego brick in a bridge, the more weight the bridge will withstand before it collapses.

Methods/Materials
To test my hypothesis, I constructed a bridge of uniformly sized Lego bricks and measured their surface area of contact. I had four sets of towers that were 16 centimeters, 21 centimeters, 26 centimeters, and 31 centimeters apart. The bridge was placed on the two towers that were 16 centimeters apart. Then, I added weights in increments of 200 grams on the center of the bridge until the bridge collapsed. I tested five other identical bridges on the same set of towers. Then I repeated the process over again on the remaining lengths of towers. All of the other bridges of different contact surface area were tested in the same way. Each size of bridge was tested six times.

Results
The less contact surface area resulted in the bridge supporting less weight. 11.14 squared centimeters could withstand the least weight of 1200 grams, and 27.46 squared centimeters withstood the most weight of 2600 grams. Also, as the length of the bridge increased, the bridge could support less weight.

Conclusions/Discussion
I concluded that the greater surface area of contact on each Lego brick in a bridge, the more weight the bridge withstood before it collapsed. So, my hypothesis was correct. I got my results because each bridge would overlap more and more, enabling it to support more weight. The bridges would also withstand less weight as the length of the bridge increased, because the towers would give less support.

Summary Statement
I wanted to find out if contact surface area of overlapping bars of steel on a bridge affected its strength.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)

Jacob A. Cohen

Project Number

J1807

Project Title

Is London Bridge Falling Down?

Abstract

Objectives/Goals

Determine how modifying the structure of a Howe Bridge changes the bridge's load carrying capacity.

Methods/Materials

Materials: Balsa/Bass wood strips; pins; wax paper; table saw; glue; sketching paper; knife; weights; cinderblocks; ruler; metal hook and bar; bucket; and scales

Methods:

1. Design and build a control bridge with no trusses. Determine its load carrying capacity by placing it between two cinderblocks and adding weights into a bucket attached to the bridge until it breaks.
2. Design and build a Howe Truss Bridge with 10 trusses and 11 truss beams. Determine its load carrying capacity by following the procedure described above.
3. Design and build variations which have different number of trusses, truss beams and materials and test their load carrying capacity. Altered variables were the number of trusses, the number of truss beams, and the type of wood.

Results

The Control Bridge had no trusses, held 13.5 pounds and weighed 28.5 grams. The Howe Bridge had 10 trusses and 11 truss beams, held 35 pounds and weighed 58.3 grams. The Howe Variation 1 Bridge had 10 trusses and 14 truss beams, held 45 pounds and weighed 71 grams. The Howe Variation 2 Bridge had 14 trusses and 15 truss beams, held 85.5 pounds and weighed 79 grams. The Howe Super Bridge, which was the same as Howe Variation 2 except that it used Bass wood, held 146 pounds and weighed 118 grams.

Conclusions/Discussion

Adding trusses increases load carrying capacity, as demonstrated by the Control Bridge, which had no trusses and held less weight than the bridges with trusses.

Increasing truss beams increases load carrying capacity, as demonstrated by the Howe Bridge, which had 10 trusses and 11 truss beams, and held 35 pound, versus the Howe Variation 1 Bridge, which had 10 trusses and 14 truss beams and held 45 pounds.

Increasing trusses increases load carrying capacity, as demonstrated by the Howe Variation 2 bridge, which held 85.5 pounds and had 14 trusses versus the Howe Variation 1 bridge which had 10 trusses and held 45 pounds.

Using stronger materials increases load carrying capacity, as demonstrated by Howe Super Bridge, which held 135 pounds and was the same as the Variation 2 Bridge, which held 85.5 pounds, except that it was made of stronger bass wood.

Summary Statement

The purpose of the project was to show how changes in bridge design can increase load carrying capacity.

Help Received

Mr. Hobbs (science teacher) helped me structure the report; Father helped me cut pieces for my bridges; Mother took pictures of me breaking bridges

Name(s)

Galen C. Dang

Project Number

J1808

Project Title

Little Plastic Bridges

Abstract

Objectives/Goals

I built a beam, arch, and suspension bridge out of LEGOS and tested to see which design held the most weight. I improved the beam, arch, and suspension bridges once and tested again to see which design now held the most weight. My hypothesis was that the arch bridge would hold the most weight before improved, but the suspension bridge would hold the most weight after improved. I just wanted to see which design would hold the most weight.

Methods/Materials

I used LEGOS to build the bridges, except for the suspension bridge where I also used fishing line, and weight anchorages. The weights I used to see how much weight the bridge could hold are quarters. The way I would test the strength of the bridge is by putting the cup attatched with string to the excact middle of the bridge deck. I used the same bridge deck for each bridge. Once the cup was in the middle of the bridge deck I would drop in ten quarters at a time. Ten quarters equals 56.7 grams. After each time I dropped ten quarters in the cup, I would measure how far to the ground the cup is with a ruler in the back in centimeters. I would continue dropping in ten quarters and measuring how far to the ground the bridge was until it broke.

Results

I found out the suspension bridge supported the most weight before and after improved. It held way more weight then the beam and arch bridge.

Conclusions/Discussion

I was wrong and right on how I guessed the arch bridge would support the most weight before improved; instead the suspension bridge supported the most weight before improvements and after. The suspension bridge supported the most weight because of the many vertical cables. Each cable helped to carry the weight of the entire bridge deck at many different points along both sides of the bridge. Each cable acted like a pier holding up the bridge deck, which is the reason why the beam bridge, with the same bridge deck length, supported less weight because it only had two piers, while the suspension bridge had seven vertical cables that took place of piers. This method of support in using cables is a much more effective way of carrying the load of the bridge deck, especially for a long spanning bridge. In conclusion, suspension bridges support the most weight and in longer distances because of the cables that act like piers on top of the bridge, reducing the number of piers on the bottom of the bridge.

Summary Statement

I built the beam, arch, and suspension bridges out of LEGOS and tested their strengths.

Help Received

Friend lent me some LEGOS.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)

Omar Espinoza

Project Number

J1809

Project Title

Demolishing Bridges

Abstract

Objectives/Goals

The objective is to see whether the Pratt truss will hold more weight then the Warren design.

Methods/Materials

I used 3/16 wooden dowels, cut them into lengths of 2 inches, 27/8 inches and 4inches. I also used Elmer's carpenter's wood glue and used pliers to cut the wood. Once i was done I had a three dimensional bridge with two sides braced together.

Results

My results were simple. I only did one test. The Pratt design held 65 pounds, the Warren design held 33 pounds.

Conclusions/Discussion

I studied two types of bridges, the Warren design and the Pratt design. I built both of them to see how much weight they could hold. I put the weight on the middle of the trusses.The Pratt design held more weight than the Warren design.

Summary Statement

I tested the Pratt and the Warren design trusses to see which would hold the most weight.

Help Received

Santigo Espinoza Jr.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)

Ian K. Flagstad

Project Number

J1810

Project Title

Carbon Fiber... Kevlar... Fiberglass...

Abstract

Objectives/Goals

In this project I was attempting to find the ansewer dealing with the bending strenth of three kinds of materials, carbon fiber, kevlar, and fiber glass.In these explorations I will conduct 9 different catagories.In each catagory I will cocnduct any where from 7-15 test.

Methods/Materials

I tested Kevlar, carbon fiber, and fiberglass in three temperatures 72 degrees, 0 degrees,and 200 degrees.Each material sat in these temperatures until finally reaching that temperature.I immediatly put the material on to an elevated surface with only the center of the material being supported.once I completed those steps I divided 465.5g. on to all four corners.I let the material hang for 3:00 min. long.The measured the angle of degrees the material came out being.

Results

In the end I found that the 0 degrees temp. increased the materials strength.The 200 degrees temp.Immensly decreased the materials streangth.The best overall material for bending came out to be kevlar.

Conclusions/Discussion

In conclusion I found that at a certan point the materials resin will melt and cause the material to become extremely flexible.In the colder condition the resin became frozen and strengthening the material.Tese results applly to all three materials.Therefore if an engineer wishes to find a material that will bend easily, like a fishing pole then they should use fiberglass.If the engineer wishes to find a material that needs to stay extremely stiff,like a bullet proof vest then they should use kevlar.

Summary Statement

The strength of kevlar, carbon fiber, and fiberglass in different conditions.

Help Received

Mother helped type report and pay for materials; adult advisor,Mr. Ryan Moulton helped with resin application; friend with resin application.

Name(s)

Layne M. Francis

Project Number

J1811

Project Title

Glue Competition on Wood. Rhino, Gorilla, Titebond, or Krazy Glue: Which Is the Strongest and Best?

Abstract

Objectives/Goals

My objective was to prove which of these four glues was the best and strongest for bonding basic craft wood and simple home furniture repairs: Gorilla Glue, Rhino Glue, Titebond III or Krazy Glue.

Methods/Materials

Materials: Krazy Glue, Gorilla Glue, Rhino Glue, Titebond III Glue. Built a wood testing frame and used round pieces of pinewood with hooks attached for the resistance testing of the glues. A fishing scale and turnbuckle were used to create the weight resistance on each test group and glue. The wood plank and balls were both sanded and cleaned to prepare the bonding surface area. An equal amount of each glue, three drops, was used on each wooden ball tested. The glues were allowed to cure for two weeks. Resistance was used until the balls released or the scale maxed out at fifty pounds.

Results

As I predicted / hypothezied, Titebond III and Rhino Glue proved to be the strongest and withstood the maximum of 50 pounds of weight pull. Krazy Glue was the weakest and Gorilla Glue had the most unreliable bonding, but could withstand more weight than the Krazy Glue.

Conclusions/Discussion

Based on my experiment, I conclude that the method of bonding, such as depriving a surface of oxygen, plays a major part in how effective a glue can bond wood together. I would recommend Rhino Glue or Titebond II because they proved to have the strongest bond ability for common craft wood such as pinewood.

Summary Statement

Out of four of the most popular glues, which are the best / strongest for bonding wood?

Help Received

Mother helped format data tables and report; Father helped construct and supervise building of display.

Name(s)
Kimberly J. Freid

Project Number
J1812

Project Title
How Does Center of Gravity Affect Crane Design?

Abstract

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

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

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

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

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

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

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
Hunter Gasca

Project Number
J1813

Project Title
Bridge the Gap!

Abstract

Objectives/Goals
The objective is to determine which through truss design ("X", Howe, Pratt) has the most structural integrity to support weight (2kg, 4kg, 6kg, 8kg, and 10kg).

Methods/Materials
Meter stick, timer, log, data tables (three per truss), two equal supports five decimeters tall, two bags of sand (4kg each), one bag of sand (2kg), wire hanger, two spring scales, and K'NEX bridge models: Control (no triangulation), "X" through truss, Pratt through truss, Howe through truss

K'NEX materials were used to facilitate bridge reconstruction. Each bridge model was tested using incremental weights. The deflection of the "roadway" was measured using a meter stick after the weight was applied for 30 seconds. Three trials were conducted for each bridge tested. Only 30 trials were conducted, since no further tests were done with greater weights when a collapse occurred. The weight averages were used to graph the data using bar charts.

Results
The control bridge supported 2kg, but failed the 4kg test. The Pratt truss supported 4kg, but failed the 6kg test. The Howe truss supported 6kg, but failed the 8kg test. The "X" truss supported 8kg, but failed the 10kg test. Therefore, the "X" truss design proved to have the most structural integrity, being the only bridge to support 8kg for any length of time. The control bridge demonstrated the most deflection and supported the least amount of weight.

Conclusions/Discussion
The control truss supported the least amount of weight due to the absence of triangulation. The "X" truss held the most weight due to maximum triangulation. Although the "X" truss model supported the most weight, it required twice as many beams to construct, and added extra weight. In real-world applications, the "X" truss may cost more and take longer to build. Therefore, depending on use, the Howe truss would be the most practical through truss design.

Summary Statement
My project is about demonstrating which through truss bridge design can support the most weight due to its structural integrity.

Help Received
Mr. Mendez (Cal Trans civil engineer) loaned me his college textbooks & responded to my interview questions; Mom helped me get materials, gave feedback on my data tables and abstract, and helped me complete applications to RIMS & CSSF; Dad supervised me while I conducted the experiment

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)

Brook Jeang

Project Number

J1814

Project Title

In Bridges We Truss

Abstract

Objectives/Goals

to discover which type of truss bridge design is more efficient

Methods/Materials

A·2 bottles of rubber cement
A·30 ball point pins
A·1 protractor
A·1 set square
A·1 engineering scale
A·1 sheet of drawing paper
A·1 T ruler
A·1 weighing scale
A·7 manila folders
A·1 pencil
A·1 eraser
A·2 wooden blocks
A·1 pair of scissors
A·Table
A·1 ruler

Results

In the primary testing, the Pratt truss bridge was able to carry 1420 grams, approximately 3.6 pounds. The Warren truss bridge was able to carry 1238 grams, or 2.7 pounds. The hypothesis was proven correct. In the secondary testing,however, when the truss members were all made the same size, the Warren truss bridge was able to carry 2394 grams.

Conclusions/Discussion

My conclusion is that the Pratt truss is able to carry more loads and is more efficient. The Pratt truss is able to carry more loads because its diagonal members are under tension. Overall costs in making truss bridges depend on materials used, transportation of parts, and construction of the bridges.
Well-constructed trusses, in which all members and diagonals match and are in proportion, form sturdy trusses. When constructing trusses, it is important that all parts fit together and are in proportion.

Summary Statement

My purpose of my project is to discover type of truss design is more efficient and able to carry more loads.

Help Received

Father helped with construction of truss bridges; Teachers (Mrs. Williams) gave advice and support

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)

Huthayfa A. Kahf

Project Number

J1815

Project Title

Concrete: Brittle, Bust, or Brick?

Abstract

Objectives/Goals

My goal was to find out if more gravel or sand makes a concrete mixture stronger. My hypothesis was that the more I increase the percentage of gravel in a mixture, the stronger it will be.

Methods/Materials

I made five different mixtures of concrete. My mixture materials included: Portland cement, coarse aggregate (gravel), fine aggregate (sand), water, and air. Then I poured each of the mixtures into the molds that I had prepared ahead of time using cardboard boxes and masking tape. After drying for three days, I then took the concrete bricks to the Twining Lab to test their strength.

Results

My hypothesis was wrong. More sand and less gravel made the strongest concrete brick. The mixture with no gravel (only sand) was the weakest, but the mixture with no sand (only gravel) was also not the strongest.

Conclusions/Discussion

My mixture #2 with 50% sand and 17% gravel was strongest because the sand absorbs more water than gravel and thus helps the cement #glue# the mixture together harder.

Summary Statement

My project is about how much sand or gravel makes concrete strongest.

Help Received

My father helped with some of the calculations. Mr. Hung Nguyen and Mr. Mike Fattal answered many questions I had and also allowed me to use the Lab equipment to test my bricks' strength.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)

Lok Lei; Rebecca Orr

Project Number

J1816

Project Title

On Shaky Ground

Abstract

Objectives/Goals

The objective of this experiment was to find a good design for buildings in areas with high earthquake hazard levels. This project was designed to find how the placement of structural openings affects a building's stability during an earthquake.

Methods/Materials

A brief description of the experiment is as follows: six types of 15cm tall building and 20cm tall buildings were made according to the designs in the procedure. Each type was built five times and placed upon the shake table. The shake table was then turned on to ".5." A stopwatch was used to determine the time it took for each structure to completely fall. The time was measured and recorded in seconds.
To conduct his experiment, 1 stopwatch, 1 shake table, and 56 Jenga blocks were used.

Results

The project results showed that as the openings of a structure became more symmetrical, the time (sec.) it took for a building to fall increased. The building models with the openings placed closest to symmetry (Type 1, 15cm tall) took on average 1.848 seconds to fall, while the building with the least symmetrically placed openings (Type 6, 15 cm tall) took only an average of 1.198 seconds. In addition, height could not be proven to dramatically affect the results of the experiment.

Conclusions/Discussion

The hypothesis, that buildings with doors and windows that are placed symmetrically will withstand earthquakes better than others, was proven correct by the experiment conducted. The data collected supported the hypothesis because as the openings were more asymmetrical in a structure, the faster the models fell. However, a change in height did not significantly affect the results of the experiment.
This project expands knowledge of structural design and where to place doors and windows for buildings in areas with high earthquake hazard levels.

Summary Statement

This project experiments with the placement of structural openings and how it affects a building's stability during an earthquake.

Help Received

Mr. Lei explained the process of building a shake table to Lok. Dr. Orr provided transportation. Financial support for materials was provided by both the Orr and Lei families. Mr. Wing Chung participated in an interview.

Name(s)
LeeAnn A. Patrick

Project Number
J1817

Project Title
Are You Ready to Rumble?

Abstract

Objectives/Goals
If a huge earthquake were to come right now, would your home be safe? While this question has many parts to its answer, one main part is structural reinforcements. The main objective of this experiment was to find the stronger reinforcement; plywood sheathing or cross-braces.

Methods/Materials
For this experiment I built four 2ft. x 2ft. model houses out of balsa wood. Two of these houses were given cross-brace reinforcements, and the other two were given plywood sheathing. A shake table was then made from particle board, springs, and rods. Each model was positioned on the shake table and weights, representing the upper story of the house, were placed on the model. The earthquake was then simulated by dropping the house, on one of the pieces of particle board, onto the springs from a predetermined height.

Results
As predicted, plywood sheathing was the sronger reinforcement.

Conclusions/Discussion
After destructive testing, I drew the conclusion that plywood sheathing is much more sturdy, and has all around better performance than cross-bracing. This is because of the distribution of force in the structure. While cross-braces only support the parts of the structure they are attached to, plywood sheathing lends support to the entire structure. This idea of force distribution is what makes plywood sheathing so much stronger than cross-braces.

Summary Statement
Comparing the performance of cross-braces and plywood sheathing against each other in an earthquake.

Help Received
Mother helped take photos and set up board; Father helped build shake table and create scale; My science teacher gave me advice.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)

Zachary A. Selig

Project Number

J1818

Project Title

Earthquake-Resistant Building Foundations

Abstract

Objectives/Goals

What kind of earthquake resistant foundation (rollers, ball bearings, or isolators) most protects buildings from earthquakes? Based on the fact that the isolators are more flexible than the rollers and the ball-bearings, I believe that in my experiment the metal and rubber washers, which function like isolators, will provide the most stability and the least displacement of the water, representing the amount of structural damage.

Methods/Materials

MATERIALS

Simulated Building,Earthquake rig, Calculator, Scissors, Flashlight, Watch, Tape measure, Camera, Plastic 2-cup capacity measuring cup, Pitcher, Water, Paper and pencil

METHODS

>Build earthquake rig

>Set up experiment site by laying down towel and clamping earthquake machine to the table so it cannot move.

>Determine performance of earthquake rig

>Run control (Foundation attached to rig table) experiment to establish baseline

>Perform steps for other foundation types.

>Make tables and graphs of your results and finish notebook.

Results

I noticed that those foundations that moved on ball bearings and rollers lost less water than those that did not. The reason the bearings resulted in the least amount of damage is because it allowed for the greatest freedom of movement. It could move freely in any horizontal direction along the top of the rig table. The bearings also had the least amount of friction between the rig table and the frame. The rollers could only move freely in one direction, and there was more friction between the rollers, the rig table, and the frame. Finally, the isolators transferred more of the vibration to the frame due to less flexibility of movement.

Conclusions/Discussion

I actually found that the ball bearings (marbles) provided the best foundation support because it caused the least amount of water loss. My data showed that the fixed foundation (control) displaced about ½ cup of water while the marbles prevented any water loss. The reason the marbles were the most successful at preventing any water displacement was that they provided the most freedom of movement, least friction, in all directions relative to the rig table.

Summary Statement

Using a variety of represenative foundations, I looked how each performed at protecting the building under standardized earthquake simulations.

Help Received

Dad helped conduct the experiment, and Mom helped with typing and layout.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)

Garrett E. Sons

Project Number

J1819

Project Title

Determining What Different Shapes of Buildings Will Minimize Damage from a Tsunami Wave

Abstract

Objectives/Goals

The purpose of my project is to see what shape of building will stand up better to a tsunami wave. What shapes of buildings along the coastline would minimize damage if a tsunami were to hit that particular beach. Making the buildings safer could save lives. The shapes of buildings I am using are square, triangle and circle.

Methods/Materials

I am conducting my testing by first building a test ocean that will create my tsunami. The size of the test ocean will be twenty-four inches wide by eight feet long by twenty-four inches deep. The reservoir will be twenty-four inches wide by twenty-four inches long by twenty-four inches deep. That will hold all the water for the tsunami. The sand beach will be five feet long by two feet wide. I will use three pieces of clay to be the foundations of my structures.

I will use candles for heavy buildings. The shape of the buildings are triangle, circle, and square. To make the buildings lighter I will use wood that is the same shape as the candle buildings. Then I will test how the buildings stand. To make the tsunami there will be a resevoir. The water will be surrounded by four walls. The water will be released to form a wave that rushes towards the beach and hits the buildings. The I will measure the lean of the buildings with a leveled protractor.

10 trials for each building material.

Results

The wood buildings. The Circle stood the best (had the least amount of lean) Next was square and finally the triangle had most damage (or lean)

Candle Buildings. (Candle stood the best. Then Square, and finally circle)

Opposite reults for weight of the buildings.

Conclusions/Discussion

With the light buildings it seemed that the shape had an effect. The water went around the buildings. (as you would expect it to) WIth the heavier buildings. The shape seemd to have less of an effect. When the wave hit the building it caused more of a collision and damage to the building.

In real life I feel the buildings are anchored in tightly and heavy enough that the shape would not matter a whole lot.

Summary Statement

I wanted to see if the shape of a building will minimize the damage from a tsunami wave.

Help Received

Teacher with paperwork, stepdad with help in construction and supervised experiments.

CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)

Jackson R. Thomas

Project Number

J1820

Project Title

Does Length Affect the Amount of Weight a Bridge Can Support?

Abstract

Objectives/Goals

I studied the correlation between length and weight support on a simple beam bridge. I thought that the longer the beam, the less weight it would support.

Methods/Materials

To do this I built a bridge out of wood and changed the length of the beam,(which was a pair of wooden skewers.)

Results

At the end, my hypothesis was supported. There was direct correlation between the length of the bridge and the weight pressed upon it. The longer the span of the beam, the more compression and tension would happen upon the beam.

Conclusions/Discussion

If there is too much weight on a beam of a certain length then it will break or snap. Bridges are an important part of transportation. If they aren't constructed properly then they might collapse and harm people.

Summary Statement

My project was to discover if there was any correlation between length and strength of a bridge span.

Help Received

My dad helped me build the bridge.