



SELMON EXPRESSWAY & USF BRIDGE DESIGN COMPETITION



February 23, 2013
BALSA WOOD BRIDGE DESIGN RULES

MATERIALS:

Balsa wood and glue are the only materials to be used.

Balsa wood: The maximum size of balsa wood used to construct the bridge is 1/4" x 1/4". Pieces of smaller dimension may be used to economize on weight. Wide pieces may be fabricated by gluing narrower pieces together. It is important to make sure that the model shop gives you balsa wood since many shops also carry other woods which may look similar to balsa.

Glue: The bridge may be built using any type of glue. The following should be considered when choosing the glue for use:

1. It is strongly suggested that *ZAP A GAP* or identical glues which are known as CYANOACRYLATES be used to construct the bridge since they "set up" or "dry" quickly, usually in less than 30 seconds. This allows you to move along quickly building your bridge. *ZAP A GAP* is usually much more expensive than the identical glues. Both types are expensive, so be careful when you use it. A little goes a long way.
2. When using *ZAP A GAP* or similar glues it is important to have a debonder readily available since the glues set so quickly that fingers are often stuck to the bridge or to each other. Debonder is usually available at the store where the glue is purchased.
3. Glues like Elmer's can be used, however the "set up" or "drying time" is usually 30 to 45 minutes and they do not achieve full strength for 24 hours or more. That means you will have to hold the pieces of your bridge together for a long time with your fingers or pins or clamps. If you are building your bridge in class the glue will not "set up" by the time you are ready to leave.

DESIGN AND CONTEST RULES:

1. The bridge shall be designed and constructed by a team of three students. One of the most important things about this project is to learn the engineering team approach to solving problems. Working, as engineers do, in a team, will result in generating ideas and improving on your first thoughts and ideas in producing the finest bridge you can.
2. The bridge contest will be scored on the following four areas of achievement:
 - A. Load capacity - The bridge will be loaded to determine how much weight it can support.



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- B. Design Drawing - Score will depend on:
1. Resemblance - The accuracy of the drawing in relationship to the bridge. The drawings may be full size or to scale.
 2. Dimensioning - Proper indication of the height, width and length of various parts of the bridge.
 3. Completeness of title block - Must indicate: Name of project, school name, teacher name, team name, Team members, grade levels and date of completion.
 4. Appearance and neatness - Quality and cleanliness of the presentation.
- C. Craftsmanship - The workmanship and care taken in constructing the bridge.
- D. Originality - Imaginative or innovative concepts used in design and construction of the bridge.
3. The bridge must be "free standing"
 4. The bridge must be constructed so as to allow a 40 cm long by 2 cm high board to slide underneath it. This means the minimum "span" of the bridge is 40 cm.
 5. The maximum height of the bridge is 30 cm.
 6. The minimum height of the "roadway surface" is 10 cm above the surface supporting the bridge.
 7. The bridge must provide a "roadway surface" that is approximately level across which a small metal car of Hot Wheels or Matchbox variety may roll, given a slight push of the hand. The roadway surface must have a minimum width of 4.6 cm. The roadway surface must extend the entire length of the completed bridge.
 8. The maximum length of the bridge shall not exceed 55 cm and the width shall not exceed 10 cm.
 9. Total mass of the bridge, including glue, may not exceed 110 grams.
 10. No fastening method other than mechanical interlock of the balsa pieces or commercial glue is allowed.
 11. The bridge design must allow the standard testing frame to be placed on the roadway surface with the testing rod(s) extending beyond the sides of the bridge. The standard testing frame is shown on the drawings attached to these instructions.
 12. The bridge may not be painted or coated in any way including coating of members with glue.
 13. The purpose in loading the bridge until it fails is to simulate the real life functioning of a highway bridge. Since any highway bridge which deflected (bent downward) seriously would immediately be taken out of service as being unsafe, any bridge in this competition which deflects more than 3.5 cm will be considered to have failed under load.
 14. In order to prevent damage to the bridge during transportation to the contest, handling and during the contest, each bridge shall be in a protective container such as a cardboard box.
 15. All bridges, when presented for judging at the competition shall have, affixed to the bridge by tag or other means, identification which shall indicate the school name, teacher name, team name and team members and grade levels.



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JUDGING:

1. Bridges will be visually inspected, measured and weighed for compliance to the rules.
2. Bridge design drawings will be examined and compared with the completed bridge.
3. Points will be given for craftsmanship, originality and design drawings.
4. The bridge will be load tested after passing the weight, dimensional and materials examination. Bridges failing to pass these requirements will not be scored in the competition. The failed bridges may be load tested at the discretion of the judges, if the team requests the test.
5. The load capacity test will be conducted as follows:
 - A. The bridge will be placed on the testing stand consisting of two flat, level surfaces which will be level with respect to each other and separated by approximately 35 cm.
 - B. The testing frame will be placed on the roadway surface at the center of the span with 1.25 cm diameter rod(s) extending beyond the sides of the bridge. The load shall be applied to the bridge from either a single rod in the center slot of the test frame or two rods placed in slots in the test frame symmetrical about the center of the span. (Whether one or two rods are used will be determined by the design of the bridge. If either option would work, the tester will use one rod.)
 - C. A testing device will slowly apply pressure downward until one of the following occurs:
 1. Catastrophic destruction takes place.
 2. The vertical force applied drops to zero.
 3. The downward deflection of the bridge exceeds 3.5 cm. The load that the bridge sustained when the deflection reached 3.5 cm will be considered to be the failure load.
 - D. If there is more than one bridge which attains the same load capacity at failure, the position of an entry will be decided by comparing the efficiency of the bridges. The efficiency of each bridge will be determined by dividing the load at failure (in kilograms) by the weight of the bridge (in grams) multiplied by 1000 [1 Lb. = 0.453592 kilograms].

$$\text{Efficiency} = \frac{\text{Failure Load}}{\text{Weight of Bridge}} \times 1000$$

SCORING:

	<u>Points</u>	<u>Maximum Points</u>
Craftsmanship	0 to 10	10
Originality	0 to 10	10
Design Drawing	0 to 10	10
Load Capacity	Highest	70
	2nd Highest	60
	3rd Highest	50
	All Others	30



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Balsa Wood Weights: Weighing done Sept. 24, 2005

1/4" x 1/4"	Balsa – 36" long	5.5 Grams/36" stick	(0.153 Gram/inch)
1/4" x 1/8"	Balsa – 36" long	4.74 Grams/36" stick	(0.132 Gram/inch)
1/8" x 1/8"	Balsa – 36" long	2.00 Grams/36" stick	(0.056 Gram/inch)
1/4" x 1/16"	Balsa – 36" long	2.40 Grams/36" stick	(0.067 Gram/inch)

You can calculate how much your bridge will weigh using this guide and measuring the lengths of the various wood sizes you intend to use in your design. Remember the weight of the glue usually is 15% of the weight of the completed bridge. The weight of the wood then would be 85% of 110 Grams or about 93 Grams. Be careful! Wood can vary in weight in accordance with moisture content and the tree it is sawn from. The heartwood in the tree has greater density than the outer wood. It is well to weight your bridge as you go along to make sure you stay within the 110 Gram limit. A good basic design value for stresses in the balsa wood is about 1,000 pounds per square inch of area in both tension and compression.

Bridge Weight Calculation (example):

Member Main Supports	Size	Number	Length in Inches	Total Length in Inches (Number x Length)	Unit Weight G/inches	Total Weight in Grams (Length x Weight)
A Sides						
Columns	1/4 x 1/4	16	12 5/8 avg	202	0.153	30.90
Tension Bars	1/4 x 1/4	4	20 1/2	82	0.153	12.54
Tension Cross	1/4 x 1/8	1	3 1/2	3 1/2	0.132	0.46
Cross Braces	1/4 x 1/16	20	3	60	0.067	4.00
	1/4 x 1/16	8	4 3/4	38	0.067	2.54
	1/4 x 1/16	8	4	32	0.067	2.14
BEA Rings						
Vertical	1/4 x 1/4	64	1 1/4	80	0.153	12.24
Binders	1/4 x 1/8	8	3 1/2	28	0.132	3.69
	1/4 x 1/8	8	2	16	0.132	2.11
Crown						
Crown	1/4 x 1/4	18	1 1/2	27	0.153	4.13
	1/4 x 1/8	2	3	6	0.056	0.33
End Bents						
End Bents	1/4 x 1/16	4	9 1/2	32	0.067	2.54
	1/4 x 1/16	6	3 5/8	21 3/4	0.067	1.45
	1/4 x 1/16	8	2	16	0.067	1.07
Roadway						
Roadway	1/4 x 1/16	14	10 1/4	143.5	0.067	9.61
	1/4 x 1/16	8	2	16	0.067	1.07
Total Balsa Wood Weight						90.82 G
Add 15% for Glue						13.62 G
Estimated Bridge Weight						104.44 G
Actual Weight on Scale						105.0 G



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Bridge Building Competition Scoring Chart:

Team Number and Name						
Load at Failure						
Weight						
Actual Weight in Grams						
Disqualified if more than 110 Grams						
Dimensions OK? Yes No						
Scoring Category		Judge 1	Judge 2	Judge 3	Judge 4	Average Score
Craftsmanship	0-10 points					
Originality	0-10 points					
Design Drawing	0-10 points					
Load Capacity						
Highest	70					
Second Highest	60					
Third Highest	50					
All Others	30					
Total Points						

If a tie occurs, highest load place will be decided by the team with the highest efficiency rating.

$$\text{Efficiency} = \frac{\text{Failure Load}}{\text{Weight of Bridge}} \times 1000$$

Materials and Supplies Required to Construct One Bridge Drawing and One Bridge:

General Store Purchases

- Pencil
- Roll of wax paper
- Packet of straight pins (about 1 inch in length with round head)
- Glue debonder (acetone – nail polish remover)
- Gallon size Zip type plastic bags
- Rubber band

Hobby Shop or Craft Store or Home Store Purchases

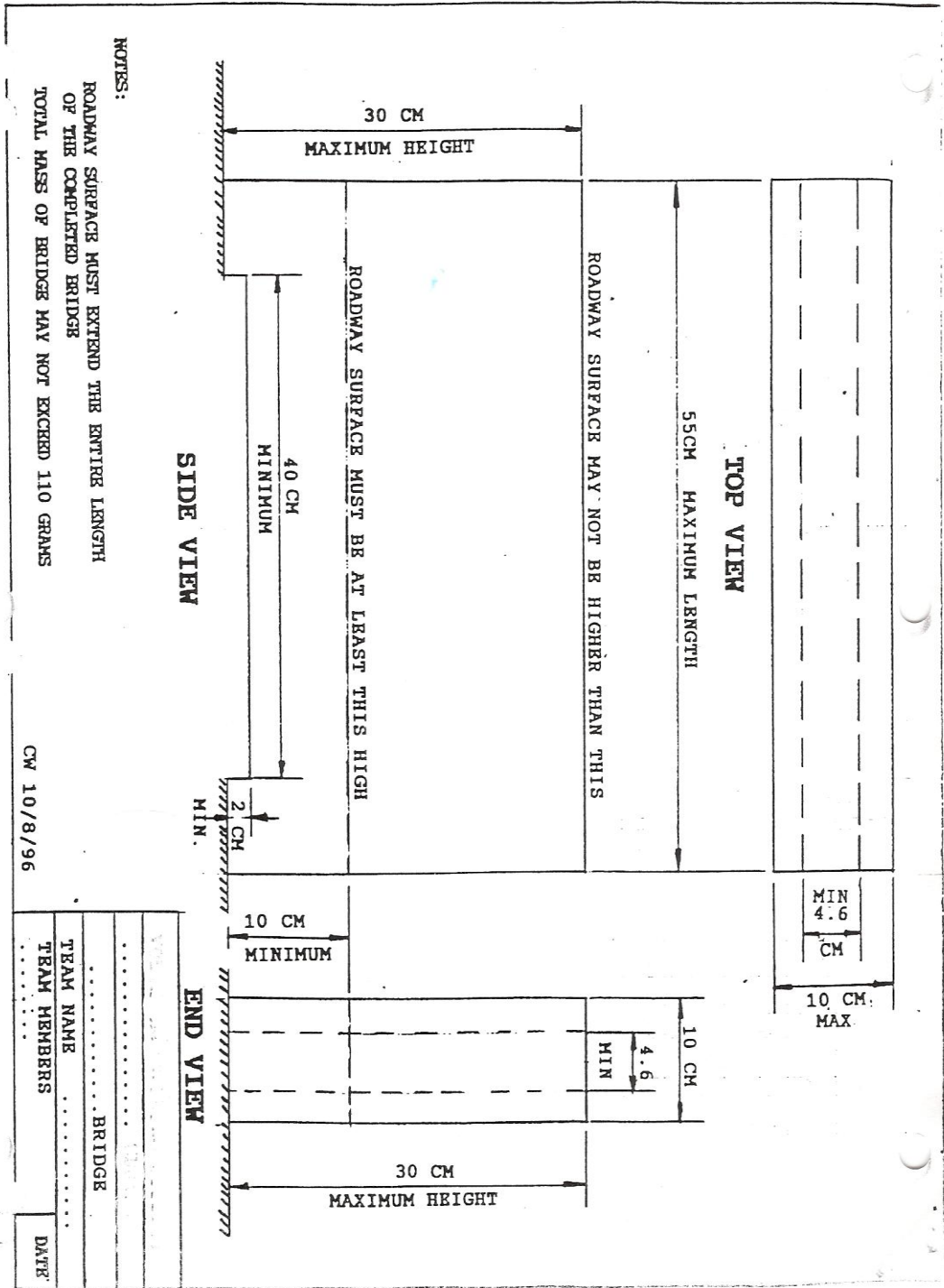
- Working board of cork or Styrofoam
- One modeling saw with fine blade
- One mitre box for modeling saw
- Small bottle of cyanoacrylate glue (super glue)
- Metric scale (or ruler)
- Straight edges and triangles (for drawing)
- Scale for weighing bridge (electronic or postal type)
- Balsa wood in 36" lengths:
 - 18 pieces of 1/4" by 1/4"
 - 6 pieces of 1/4" by 1/8"
 - 10 pieces of 1/4" by 1/16"

Contest Coordinator Will Supply to Contestants

- Bridge Rules
- One 11" by 17" Bridge Footprint Template
- One sheet of 24" by 36" Drawing Paper



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NOTES:
 ROADWAY SURFACE MUST EXTEND THE ENTIRE LENGTH OF THE COMPLETED BRIDGE
 TOTAL MASS OF BRIDGE MAY NOT EXCEED 110 GRAMS

CW 10/8/96

TEAM NAME BRIDGE
TEAM MEMBERS
DATE



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HOW DO THEY DO IT?

PBS.ORG-Building Big

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Try it!

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West Point Bridge Design

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Download the West Point Bridge Designer

The West Point Bridge Designer 2011 will be available on January 10, 2011. This is the only version of the software that can be used to enter the 2011 West ...

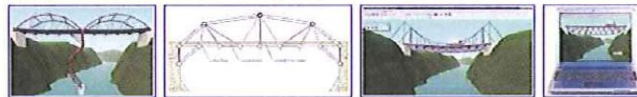
bridgecontest.usma.edu/download.htm - Cached - Similar

West Point Bridge Design

The United States Military Academy is pleased to offer the West Point Bridge Design Contest. The purpose of the contest is to provide middle school and high ...

www2.cmcss.net/~MCHS/~/WestPointBridgeDesign.htm - Cached - Similar

Images for West Point Bridge Design - Report images



PDF ST. LOUIS WEST POINT BRIDGE DESIGN CONTEST

File Format: PDF/Adobe Acrobat - Quick View

2010 West Point Bridge Design Contestants: RULES UPDATE AND ASSISTANCE ...

Download and install the West Point Bridge Designer 2010 software (free software, ... www.slapt.org/events/2010West_Point_Contest.pdf

Videos for West Point Bridge Design



West Point Bridge Design 2003 Glitch
19 sec - Jun 17, 2007
Uploaded by EagleBoy13524
www.youtube.com



Cheap West Point Bridge Design free!!!
1 min - Dec 3, 2008
Uploaded by Rocklobstaa
www.youtube.com

BridgeBuilder-Game.com - The ultimate bridge building game page

As long as our own contest hasn't started yet, we recommend taking part in the 2005 West Point Bridge Design Contest, that will begin on January 6, 2005. ...

www.bridgebuilder-game.com/ - Cached - Similar

PDF Opening Westpoint Bridge Designer :

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Opening Westpoint Bridge Designer: 1. Click on the Start Menu. 2. Using your mouse, left-click on CAE Applications. 3. Move your mouse to Engineering and ...

www.engr.wisc.edu/outreach/tutorials_files/BridgeDesigner.pdf - Similar

West Point Bridge Design Contest - Chief Delphi

Jan 4, 2010 ... West Point Bridge Design Contest General Forum. ... We had to design in West Point, then actually build it out of basswood. ...

www.chiefdelphi.com/Chief-Delphi/FIRST/General-Forum - Cached

Can someone help me with my West Point Bridge Design? - Yahoo!

Answers

Feb 7, 2010 ... I have mine down to, like, 200000. Does anyone ever use it and if so ... haha yeah i had to do that from one of my grade 9 computer classes... ...

answers.yahoo.com/question/index?qid... - Cached - Similar

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balsabridge.com - Records, rules and tips for this twenty year old ... - balsabridge.com

Model-Bridge-Design - Tips and advice about designing and ... - garrettsbridges.com

the-contest-website - Bridge Building Contest Home Page. ... - bridgecontest.phys.iit.edu

Bridge-Builders - Our first Spotlight Video profiles United 2 ... - bridge-builders.ning.com