Tip Sheet for 2014 Bridge Building Contest

Our number one goal is for the Regional Bridge Building Contest to be a rewarding and learning experience for each student who competes. Building a bridge that meets all specifications is a major accomplishment in itself. We prepared this sheet containing a few helpful hints to assist students throughout their bridge building process.

1) Before getting started with design & construction, read the specifications slowly & thoroughly (more than once). You must know each and every rule completely before beginning your design.

2) If there is any specification that you do not completely understand, then ask for clarification.

3) Use a glue that will rigidly connect the members so they do not flex after the glue dries. We have observed great success using basic white Elmers glue. (Do NOT use Tacky Formula Modeling Glue).

   Glues that will work:
   - Elmer's Glue-All Multi-Purpose Glue
   - Elmer's Washable, No Run School Glue
   - Green Structures Glue from Pitsco (setup & clamping time is 30 – 45 min)
   - SuperGlue
   - Wood Glue

4) Most bridges entered in this competition will be truss bridges (you can look on the internet for examples of various types of truss bridges). These bridges are composed of two trusses which are the basic elements of the bridge to carry the load to the supports. These trusses are on the sides of the bridge. A truss is simply a structural assembly made up of a series of triangles. These trusses MUST be properly connected to each other by various other members to make sure the trusses do not separate or fall over during the loading process of the competition. Lateral bracing, sway bracing, and/or portal bracing are needed to tie the trusses together and stabilize the bridge in the horizontal and cross-sectional planes. Stability in the longitudinal plane is provided by the truss itself. Remember, we are dealing with a 3-dimensional structure which requires stability in ALL 3 PLANES (X-Y plane, X-Z plane, & Y-Z plane).

   Lateral stability of a bridge is extremely important to a successful design. You should design your bridge with adequate lateral bracing to prevent the bridge from tipping over or separating. This is even more critical on taller bridges. You could also make the bridge width at the bottom a little bit wider than at the top to help with the lateral stability. *(For example: if you have a taller bridge, then you could use a 60 mm width at the bottom of the bridge and say 35 mm width at the top. This leaning effect of the side trusses on each other would help prevent tipping over to one side and give additional lateral stability.)*

5) The maximum mass of the bridge is 25.00 grams. If possible, occasionally check the mass of various assemblies throughout your building process to see where you stand in relationship to the maximum mass. Remember that glue is heavy and moisture in the air can add a gram or so to your bridge, so limit your mass to say no more than 24 grams. Another reason to keep it less than 24 grams is slight variations in the accuracy of scales. You might weigh your bridge with a scale that reads a little on the light side and when it gets weighed for the competition using our accurate scale, it could be more than what your scale showed. Remember, the winner is based on the highest efficiency. Lighter bridges do not have to carry as much load to have high efficiencies and generally outperform heavier bridges. The better bridges in past competitions usually had masses in the 14 to 20 gram range.

6) Stay away from all minimums and maximums. Pieces do not always go together as planned and being outside the limits by even one millimeter will result in disqualification. (Example: since the maximum width is 80 mm, then give yourself a couple millimeters leeway in design and do not make it any wider than say 78 mm.)

7) The span is 300 mm long and the length of the bridge cannot be longer than 400 mm. Since the bridge must rest on the support surface, give yourself at least 10 mm of support on each side of the span making the minimum length of your bridge 320 mm. You do not need a length much more than 320 mm to carry the load and any additional length could hurt your efficiency.

8) Laminating 2 or more pieces of wood together in certain places is usually beneficial. I would consider laminating the members that will directly support the load, compression members and the legs.

9) All clearances and rules must be observed in order to meet specs.
Here are a few of the other critical rules to observe:
   - Bridge width must be less than 80 mm
   - Loading plane must at least 100 mm above the support surface
   - Maximum overall height of bridge above the support surface is 200 mm
   - No part of the bridge may extend below the lower support surface
   - There are 2 possible loading locations that will support a 50 mm x 50 mm plate. Loading locations are 50 mm to the right of center and 50 mm to the left of center. Bridge must be designed to accept both of these possible loading locations.
   - Read the rules thoroughly and make sure that you are meeting *ALL* specifications.

10) There are numerous ways to design & build a model bridge. The suggestions shown below are by no means the only way in which a bridge can be built. There may be other ways that could be better. Use your imagination on the design and construction of your bridge. The suggestions below are only that (SUGGESTIONS) and are intended to get you thinking on how you will build your bridge.

    A) Design your bridge and get your ideas on paper before you begin constructing your bridge. Draw the side view of your bridge *TO FULL SCALE* (actual size) on a piece of paper.

    B) Think ahead of how each section fits together and how sections are connected.

    C) When building the two sides of your bridge, start with your full-scaled drawing taped down to the top of a table. Place a piece of waxed paper over your drawing and tape down those edges. This will prevent each assembly from adhering to your drawing or to the table. Cut and place basswood pieces as shown on your drawing.

    D) Use masking tape to fasten basswood pieces to the waxed paper during the gluing process. This will temporarily hold the pieces together while the glue dries.

    E) Immediately after you glue the side assembly, place another piece of waxed paper on top of that assembly, then place some sort of weight like a book or large piece of wood on top of the waxed paper. This will insure that the side assembly will be flat after the glue dries.

    F) *If you decide to make an arch, you will need a board that you can hammer in small nails (wire brads). First, tape your drawing to that board, then place waxed paper on top of your drawing and tape the waxed paper to the board. Hammer the small nails at key locations, then bend the basswood around the nails to form the curved shape. (Curves must be gradual, because a sharp curve will cause the stick to break.) Glue various pieces to the curved piece to keep it curved. After the assembly dries, remove the assembly from the nailed board. You might have to slightly bend or remove a few nails before removing the assembly from board.*

G) Stand up the two sides of the bridge and glue the connecting members. You can use tape, books, blocks, etcetera to hold the side ups during this process.

H) Glue on lateral bracing and side bracing to stabilize your structure.

11) The strength of your bridge will be determined by the weakest link in the design. This will be the location where failure will occur first. If your bridge is say 78 mm wide at the loading area and has only two individual basswood sticks as support beams connecting the two main trusses, then failure of those two sticks will probably occur first. A single basswood stick is not very strong as a beam or flexural member. These beams directly support the loading plate and need to be strong enough to transfer the load to the sides of the bridge. These single sticks will break before the load is ever transferred to the sides. It is advisable to laminate 3 or 4 sticks as the beam for transferring the load from the loading plate to the two main trusses on the sides. Make sure that these beams frame into the joint location of the two main trusses on the sides. (NOTE: To avoid using beams to transfer the loads to the side trusses, make the bridge 35 mm wide at the loading plane height. With this arrangement, the load is transmitted directly to the side trusses.)

12) Official registration will be on February 28th and March1st at WKU Center for Research & Development Commons Area. If the bridge needs to be altered at time of registration, it can be worked on by the student only.

13) **REMEMBER:** Each bridge entered must be built and designed by one student. The entire design and construction of the bridge must be done ***by the student***. It is extremely important that each bridge be designed & checked using the attached checklist before bringing the bridge to the contest. Changes can be made on the day of the competition if a specification is not met; however, those changes can only be made ***by the student***. A fast-drying glue should be used if corrections are made on the day of the competition.

GOOD LUCK AND WE LOOK FORWARD TO SEEING YOU AT THE COMPETITION!