General Information for *Applied Mechanics* Students

You may work in teams of 2 on this project. It is *your* responsibility to ensure that I can use the testing device with your bridge. If it doesn't fit, *you* lose. I recommend binder clips for use as wood clamps while your glue dries. If you choose not to clamp your glue while it dries, you might as well use water instead of glue. The properties of balsa wood are listed on the reverse side. The web site has a link to *garrettsbridges.com*, which is maintained by a teacher in Georgia who has a lot of advice on building Balsa bridges. I won't vouch for his accuracy. Finally, you don't have the right to use any physics department resources to aid in your construction. If you hope to use any departmental clamps, weights, tables, etc. during your construction, you must get permission beforehand (e.g., from Dr. McLean, or from an *Intermediate Lab* instructor).

Bridge Grading

You will earn 80 points for building a bridge that meets the printed rules (subject to the grade modifications below). In addition, you may submit an analysis of your bridge, worth 20 points. This analysis must be submitted *before* the contest. This task is not easy. You must compute all relevant normal and shear stresses for your final design. The report is primarily text and diagrams (including free body diagrams). You will need to *state* and *justify* all the assumptions that you make. Please note that stating assumptions is *not* the same as justifying them. For example, it is not clear to me that glued joints can be approximated as pin joints, and therefore, your bridge is probably not a truss. However, if you choose to treat connections as pin joints anyway, you should first demonstrate, mathematically, that it is *reasonable* to do so. As a conclusion to your report, you should predict the expected maximum load for your bridge, including the location of failure.

Your grade will be subject to some bonuses/penalties depending on the final strength. If the weight held is W, then:

$0 < W \leq 10$kg	Bonus = – 40 points	
10kg $< W \leq 15$kg	Bonus = – 20 points	
15kg $< W \leq 20$kg	Bonus = – 10 points	
30kg $< W \leq 40$kg	Bonus = + 10 points	
40kg $< W$	Bonus = + 20 points	
Team of 2	Bonus = + 0 points	
Team of 3	Bonus = – 5 points	*requires special permission
Winning Bridge	Bonus = + 15 points	
Second Place	Bonus = + 10 points	
Style: "unique"	Bonus = + 10 points (<30% of bridges use your basic design)	
Style renege:	Bonus = – 10 points (changed basic design w/o approval)	

Minimum possible Grade: 0/100 Maximum Grade allowed: 120/100

You should carefully note that while *winning* is based on the ratio of weight held to the weight of your bridge, your *grade* is more strongly dependent on holding a lot of weight regardless of whether the bridge is light or heavy. As a result, it is probably in your best interests for purposes of the class to make a heavier bridge.

Approximate Mechanical Properties of Balsa Wood

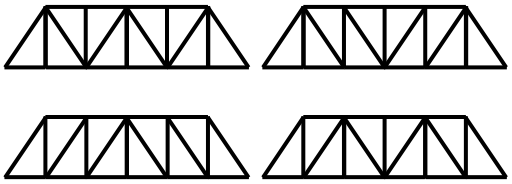
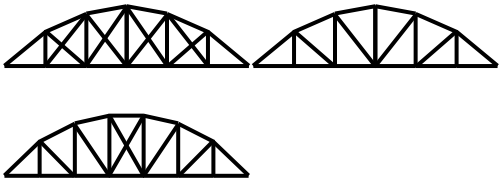
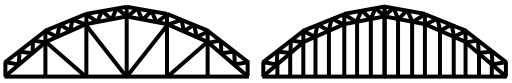
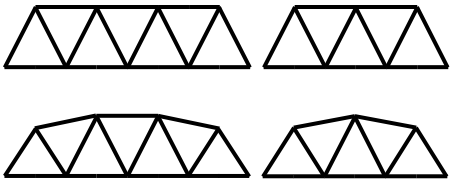
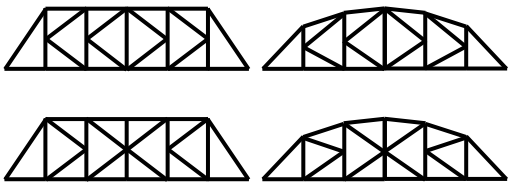
This mechanical data for balsa wood was originally published by the US Department of Agriculture in the 1930s and 1940s. Properties may vary for several reasons:

1) No two trees grow exactly the same.
2) Wood is not isotropic (it has a grain).
3) Results are strongly dependent on the grain direction.

Loading Parallel to the Grain ("end grain")	
Compressive stress at proportional limit ($\|\sigma_y\|$; psi)	2310
Ultimate compressive strength ($\|\sigma_u\|$; psi)	2950
Modulus of elasticity (E; ksi)	1164
Loading Perpendicular to grain ("flat grain")	
Compressive stress at proportional limit ($\|\sigma_y\|$; psi)	145 to 198
Modulus of elasticity (E; ksi)	19.9 to 55
Bending Strength (determined using a 3 point static test)	
Stress at proportional limit ($\|\sigma_y\|$; psi)	2535
Modulus of elasticity (E; ksi)	925
Tensile Strength	
Loading parallel to grain ("end grain") (σ_y; psi)	4525
Loading perpendicular to grain ("flat grain") (σ_y; psi)	156 to 223
Shear Strength	
Parallel to grain (τ_y; psi)	425 to 522

Table of Possible Designs

You are welcome to also choose designs that don't fit into any of these categories!

	Type	Examples
1	Flat Top with right triangles. (Warren, Pratt, etc.)	
2	Curved Top with right triangles and/or counters. (Bowstring, Parker, Camelback, etc.)	
3	Arch with triangles or with stringers. (Tied Arch, etc.)	
4	Flat or curved tops with non-right triangles. (Warren, etc.)	
5	Left or Right facing "K" shapes with either curved or flat tops. ("K" truss, etc.)	
6	Other (not like any of the above!)	??