General Information for *Applied Mechanics* Students

You may work in teams of 2 or 3 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.

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 must 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. 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, as well as the location of the onset 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 = + 5 points	
Team of 3	Bonus = + 0 points	
Winning Bridge	Bonus = + 15 points	
Second Place	Bonus = + 10 points	
Compute $W \pm 5\%$	Bonus = + 30 points	Computing ≠ Guessing

Minimum possible Grade: 0/100 Maximum Grade allowed: 150/100

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 to make a heavier bridge.

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) Wood behaves differently in tension than in compression.

	Weight Density (lb/foot^3)		
	6	**11**	**15.5**
Loading Parallel to the Grain ("end grain")			
Compressive stress at proportional limit ($\|\sigma_y\|$; psi)	500	1450	2310
Ultimate compressive strength ($\|\sigma_u\|$; psi)	750	1910	2950
Modulus of elasticity (E; ksi)	330	768	1164
Loading Perpendicular to grain ("flat grain")			
Compressive stress at proportional limit ($\|\sigma_y\|$; psi)	50 to 84	100 to 144	145 to 198
Modulus of elasticity (E; ksi)	5.1 to 16	13 to 37	19.9 to 55
Bending Strength (determined using a 3 point static test)			
Stress at proportional limit ($\|\sigma_y\|$; psi)	825	1725	2535
Modulus of elasticity (E; ksi)	280	625	925
Tensile Strength			
Loading parallel to grain ("end grain") (σ_y; psi)	1375	3050	4525
Loading perpendicular to grain ("flat grain") (σ_y; psi)	72 to 112	118 to 170	156 to 223
Shear Strength			
Parallel to grain (τ_y; psi)	158 to 180	298 to 360	425 to 522