General Information for *Applied Mechanics* Students

You may work alone or in a pair 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 have some binder clips available that you can be use as wood clamps. The properties of Balsa wood are listed below.

Bridge Grading

You will earn 70 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 30 points. This analysis must be submitted *before* the contest. You might start by assuming a 100 unit weight is applied to the testing device, and from there, determine all the relevant *stresses*. This is not easy. You must compute the 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 better 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 $< W \leq$ 15kg	Bonus = – 20 points
15kg $< W \leq$ 20kg	Bonus = – 10 points
30kg $< W \leq$ 40kg	Bonus = + 10 points
40kg $< W$	Bonus = + 20 points
Winning Bridge	Bonus = + 15 points
Second Place	Bonus = + 10 points
Compute $W \pm 5\%$	Bonus = + 30 points

Minimum possible Grade: 0/100 Maximum Grade allowed: 140/100

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 ($\|s_y\|$; psi)	500	1450	2310
Ultimate compressive strength ($\|s_u\|$; psi)	750	1910	2950
Modulus of elasticity (E; ksi)	330	768	1164
Loading Perpendicular to grain ("flat grain")			
Compressive stress at proportional limit ($\|s_y\|$; 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 ($\|s_y\|$; psi)	825	1725	2535
Modulus of elasticity (E; ksi)	280	625	925
Tensile Strength			
Loading parallel to grain ("end grain") (s_y; psi)	1375	3050	4525
Loading perpendicular to grain ("flat grain") (s_y; psi)	72 to 112	118 to 170	156 to 223
Shear Strength			
Parallel to grain (t_y; psi)	158 to 180	298 to 360	425 to 522