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Dear Mr. Shorrock,

I am reporting to you in regard to the results of the beam and column experiments as well as the SAP2000 lab. The beam experiment tested various aluminum beams under different loads using simple supports. While the column test found the max load for elastic buckling. The last part was in SAP2000 where beam displacement was simulated.

In the first experiment, the group conducted in lab 4 was the column test. The column's dimensions were calculated in Table A.1. As well as the moment of inertia in order to find the Axial load that causes elastic buckling (Calc A.1). Then, the group actually performed the axial capacity test by placing weights onto the top of the column until it buckled. The next part of the column test used a brace at the midpoint of the column, which greatly increased the amount of load needed for axial capacity. In the next part of the lab, the group used a simply supported system set up 12 inches apart to access the displacement of 3 three beams of different dimensions when exposed to loads in the middle of the supports. A ruler was used to measure the deflection rounding to 0.125 inches. This value for displacement was found by Subtracting the initial height of the beam from the height when loaded. The final step for the lab was to measure the displacement of 2 combined beams that had three bolts between them versus 2 attached beams that were stuck together. Lab 5 was a tutorial on SAP2000 software. It simulated the displacement of the first Three Beams in the beam behavior test using the first, middle, and final loads. This gave us the ability to compare the results of SAP to the experiment by graphing both Beam results together (Figure A.2-A.4).

Looking at the data for both beams in the experiments, the findings show that both tests were successful in finding linear trends. The experiment with simply supported beams carried out in the Guinness lab had less of a perfect trend compared to the online SAP software. For example, in Figure A.4, SAP Seemed to give a more accurate trend of the three loads, while the experiment yielded a less perfect trend. This discrepancy could be a source of human error through misreading the tape measuring length for the displacement. Also, it is possible that a beam wasn't in the middle of the supports or there may have been a communication error when recording the data. For the combined load test it was clear that beam 2 combined had much less displacement than its counterpart. Its displacement on the fifth load was 0.25 inches, compared to the beam attached which was 0.900 inches (table A.3). This is represented well in my combined graph (Figure.A.5) where the displacement for the combined is much smaller than the attached. The combined beam had bolts in between the two aluminum beams, compared to the two normal attached ones. The three metal bolts gave the aluminum more rigidity and resistance to the load. The column results were similar as well. Using the calculation for the max load (Pe), the group effectively got similar results in the actual test. The only outlier was the 4th specimen for the observed Pe in table.A.4. This number is wrong because the column could not fail with the weights provided. Again, the max load capacity test used increments with the weights we had so some of the max loads were off compared to the estimated because we couldn't increment with the correct weights because of our limitations on time and specific weights. A strength increase was observed due to the brace because the calculated estimate involves the length. Because L acts inversely to Pc, a smaller column length brings more strength. The cross-section also affects the axial load to cause elastic buckling because the thicker columns had higher strengths because of the moment of inertia or Ix value in table.A.3 was used to calculate this value. The last part of the lab was the TA demo of brace strength. Some of the conclusions were that if the brace was not stiff enough, the column would still buckle for the whole column. Yet, when the brace was secure, the axial capacity load increased and the column was forced to buckle in between the braces and the ends giving it more strength.

Regarding these findings, the trends seem to match up with all the beams as well as the columns. These principles are really important in real-life buildings and structures. I am glad I got to work with the beams and columns to apply my calculations to simulations and experiments.

Sincerely,

Nicholas Valianti

Appendix A:

Table A.1. gives the results of the Beam specimen's dimensions and properties.

Dimensions					
Specimen	L (in)	W (in)	T (in)	Ix	Iy
1	24	2	0.038	0.000009145333333	0.02533333333
2	24	2	0.063	0.0000416745	0.042
3	24	2	0.0625	0.00004069010417	0.04166666667

Table A.2. is the results of the Beam deflection experiment.

Initial height (in):	4.46875		4.46875		4.5	
	Beam 1		Beam 2		Beam 3	
	Load (lb)	Displacement (in)	Load	Displacement	Load	Displacement
	0.527	0.25	1.022	0.09375	1.749	0.0625
	0.996	0.4375	2.035	0.18775	3.47	0.187
	1.523	0.625	3.023	0.24975	5.196	0.25
	2.019	0.51475	4.035	0.37475	6.934	0.313
	2.514	1.09375	5.042	0.43775	8.15	0.344

Table A.3. gives the results of the 2x Beam combined vs Beam attached.

Initial height(in):	4.718	4.496
	2X Beam 2 combined	2X Beam attached

	Load (lb)	Displacement (in)	Load	Displacement
	1.749	0.093	1.749	0.308
	2.463	0.155	2.463	0.4335
	3.47	0.188	3.47	0.621
	4.179	0.218	4.179	0.746
	5.196	0.25	5.196	0.902

Table A.3. Encompasses the column Axial load capacity test and the calculated moment of inertia values.

Dimensions						
Specimen	L (in)	W (in)	T (in)		Ix (in^4)	Iy (in^4)
1	24	0.518	0.0375		0.000002276367188	0.000434349475
2	24	0.99	0.032		0.00000270336	0.002587464
3	24	0.9935	0.0385		0.000004724640995	0.003146176608
4	23.8	1.026	0.076		0.000037532448	0.006840288648

Table A.4. is the estimated or calculated results for the column test and the observed results of the column test.

	No Brace		Brace at Midheight	
Specimen	Pe estimated (lb)	Pe observed (lb)	Pe estimated	Pe observed
1	0.3900487093	0.5401325419	1.560194837	1.537
2	0.4632126507	0.5401325419	1.852850603	1.9624
3	0.8095531039	0.9773092074	3.238212415	3.493
4	6.539612107	6.771277915	26.15844843	17.65

Table A.5.

This data is the raw results of the Axial capacity buckling failure test for the braced and unbraced columns.

Testing failure

	Unbraced		Braced	
Specimen	Grams	Pounds	Grams	Pounds
1	245	0.5401325419	697.1714733	1.537
2	245	0.5401325419	890.1296676	1.9624
3	443.3	0.9773092074	1584.39815	3.493
4	3071.4	6.771277915	8005.905337	17.65

Figure A.1.
Beam 1 load 2.514 lbs (SAP image)

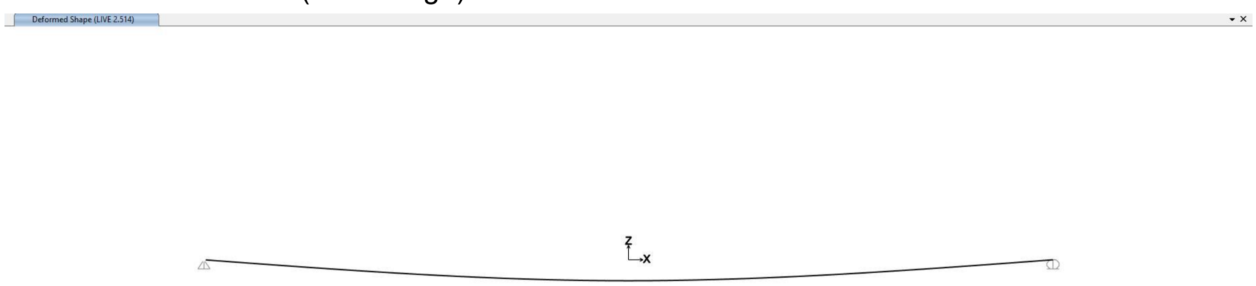


Figure A.2. The figure represents the results of the Beam deflection experiment (Blue) along with the SAP Simulation Deflection experiment (Orange) for Beam 1.

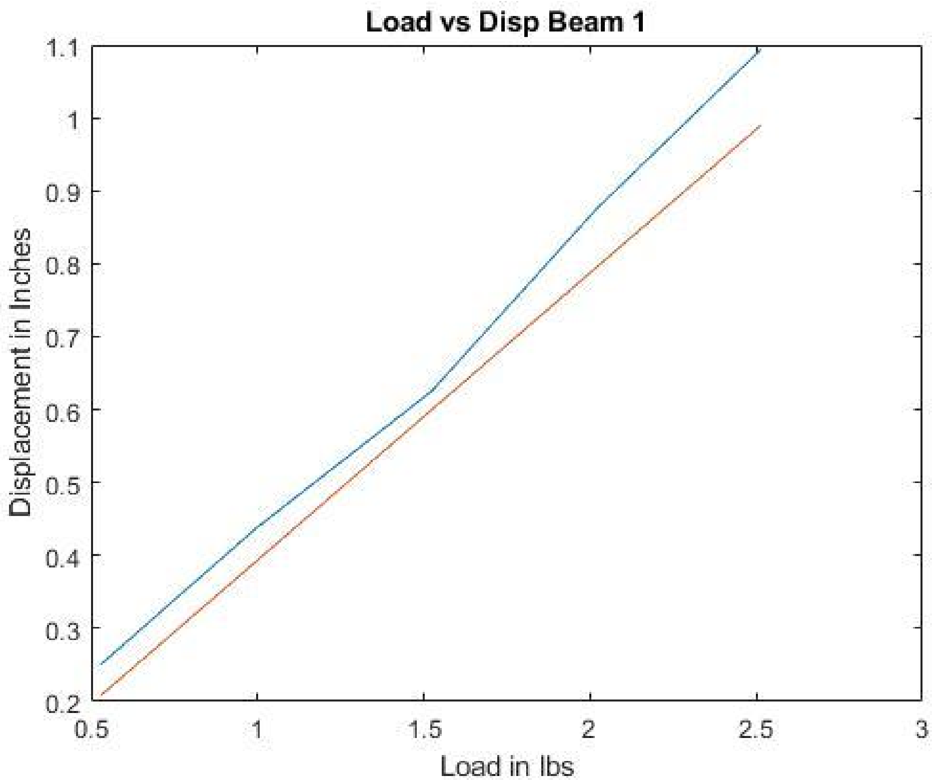


Figure A.3. The figure represents the results of the Beam deflection experiment (Blue) along with the SAP Simulation Deflection experiment (Orange) for Beam 2.

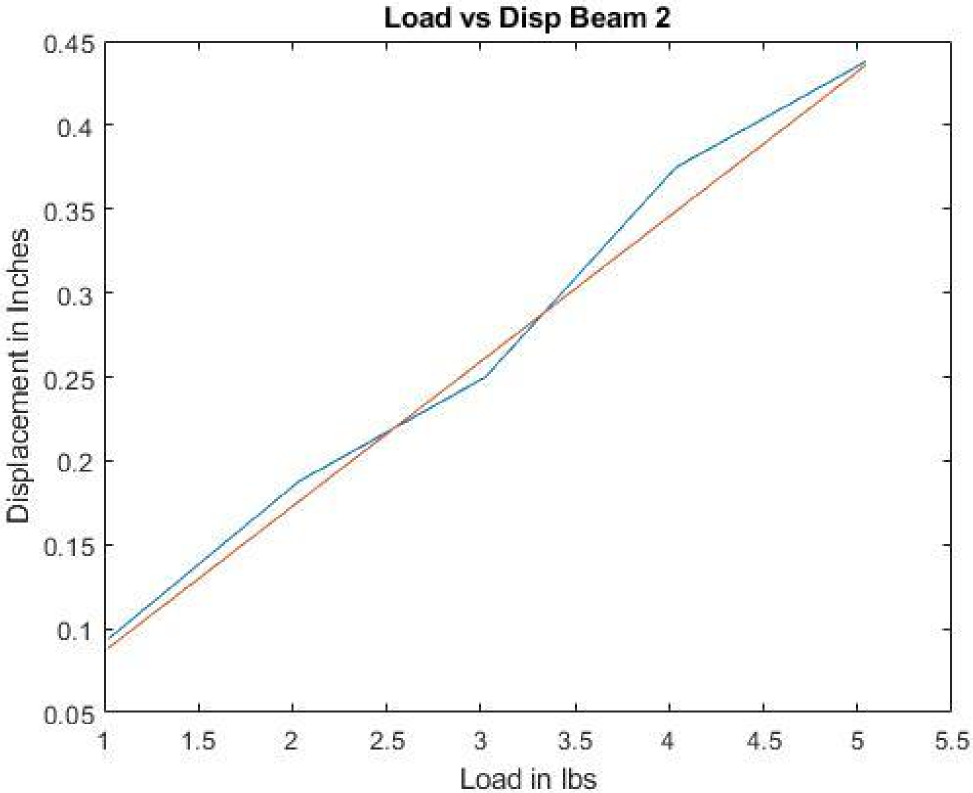


Figure A.4. The figure represents the results of the Beam deflection experiment (Blue) along with the SAP Simulation Deflection experiment (Orange) for Beam 3.

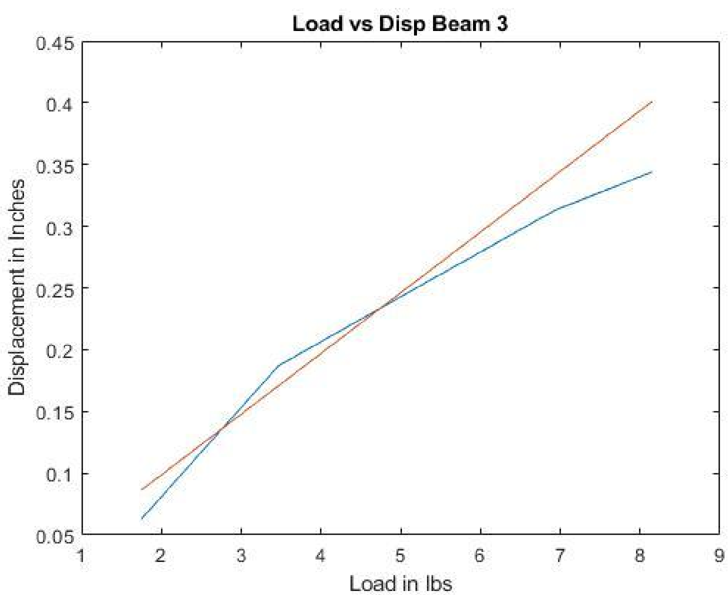
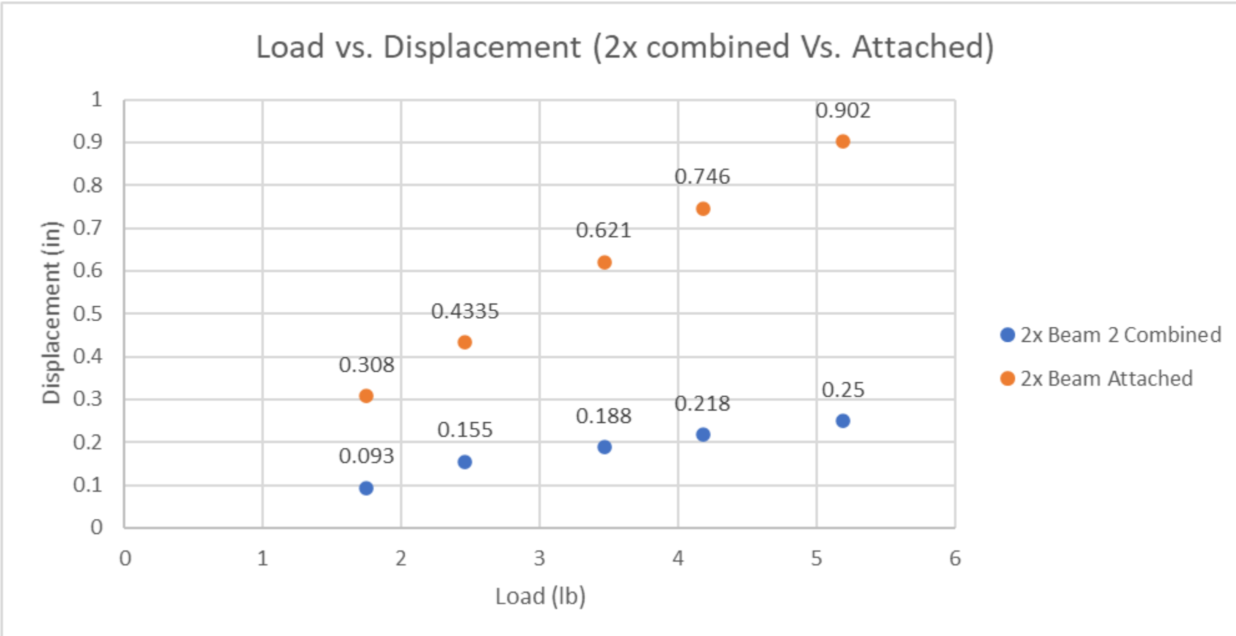


Figure A.5. Shows the trend in load vs. Beam displacement of the combined vs. Attached beams.



Calculations:

Calc.A.1.
Ix = (Width x thickness^3)/12 (*used for Pe)
Iy = (thickness x width^3)/12

Calc.A.2.
No brace = Pe = (pi^2*E*Ix) / L^2 = (for specimen one no brace) = (3.14^2*100000*Ix1)/(24^2) = 0.39 lb
Brace column = Pe = (pi^2*E*Ix) /(L/2)^2

Calc.A.3
(Displacement for Table.A.2-A.3) = initial height - loaded height = displacement