LAB REPORT #4 :
Strain Gauge Lab

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by

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Hannah Spiller Lab 4

a) The published values for the bending modulus of aluminum 6061 is 9900 psi and the shear modulus is 3800 ksi.

Table 3.6.2.0(c_1). Design Mechanical and Physical Properties of 6061 Aluminum Alloy Tube and Pipe

Specification	AMS-WW-T-700/6		AMS 4080, AMS 4082, and AMS-WW-T-700/6
Form	Drawn tube		
Temper	T4	T42[a]	T6[b] and T62
Wall Thickness, in. ..	0.025-0.500	0.025-0.500	0.025-0.500
Outside Diameter, in.	...		
Basis	S	S	S
Mechanical Properties:			
F_{tu}, ksi:			
L	30	30	42
F_{ty}, ksi:			
L	16	14	35
F_{cy}, ksi:			
L	14	...	34
F_{su}, ksi	20	...	27
F_{bru}, ksi:			
(e/D = 1.5)	48	...	67
(e/D = 2.0)	63	...	88
F_{bry}, ksi:			
(e/D = 1.5)	22	...	49
(e/D = 2.0)	26	...	56
e, percent:			
L	[c]	[c]	[c]
E, 10^3 ksi	9.9		
E_c, 10^3 ksi	10.1		
G, 10^3 ksi	3.8		
μ	0.33		
Physical Properties:			
ω, lb/in.^{3}	0.098		
C, K, and α	See Figure 3.6.2.0		

b) The bending and shear forces are found using the equations below.

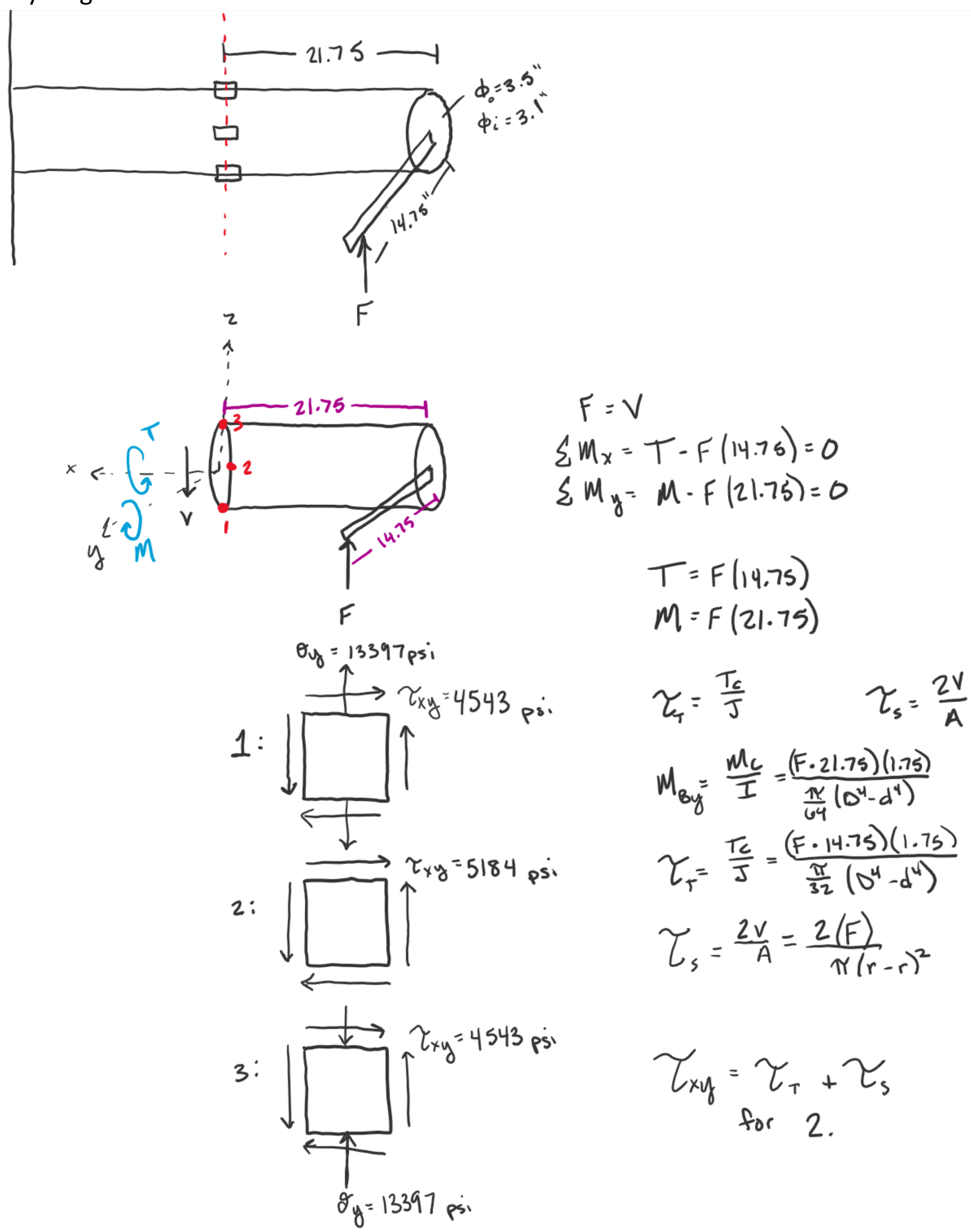
$$\sigma_{bending} = \frac{Mc}{I} \qquad \tau_{torsion} = \frac{Tc}{J} \qquad \tau_{transverse\ shear} = \frac{2V}{A}$$

Where:

$M =$ Bending Moment
$c =$ Distance from neutral axis
$I =$ Moment of Inertia
$T =$ Torque

$J =$ Polar Moment of Inertia
$V =$ Shear Force
$A =$ Area

The free body diagram with the forces is shown below.



Using the equations at the applied load of 997 lbs, the bending stress was 13397 psi, the torsional stress was 4543 psi, and the transverse shear stress was 641 psi. The stress elements on the top and bottom of the pipe had no transverse shear with bending and torsion and the stress element in the middle only had torsion and transverse shear. There is no bending along the bending axis and the top of the bar experienced compression while the bottom experienced tension. All the calculated values at all the loads can be found in the table below.

Table of Calculated Stresses

Applied Load (lbs)	Bending (psi)	Torsion (psi)	Trans Shear (psi)
0	0	0	0
201.67	2709.659	918.7924	-194.525923
403.19	5417.302	1836.901	-388.907161
598.49	8041.373	2726.673	-577.288739
797.07	10709.51	3631.387	-768.834124
997.09	13397	4542.662	-961.768498

c) The measured values of stress were found using the equations below.

$\sigma_{bending} = E * \varepsilon$ $\tau_{torsion/shear} = G * \gamma$

Where:

$E =$ Modulus of Elasticity (9900ksi)

$\varepsilon =$ Measured Strain

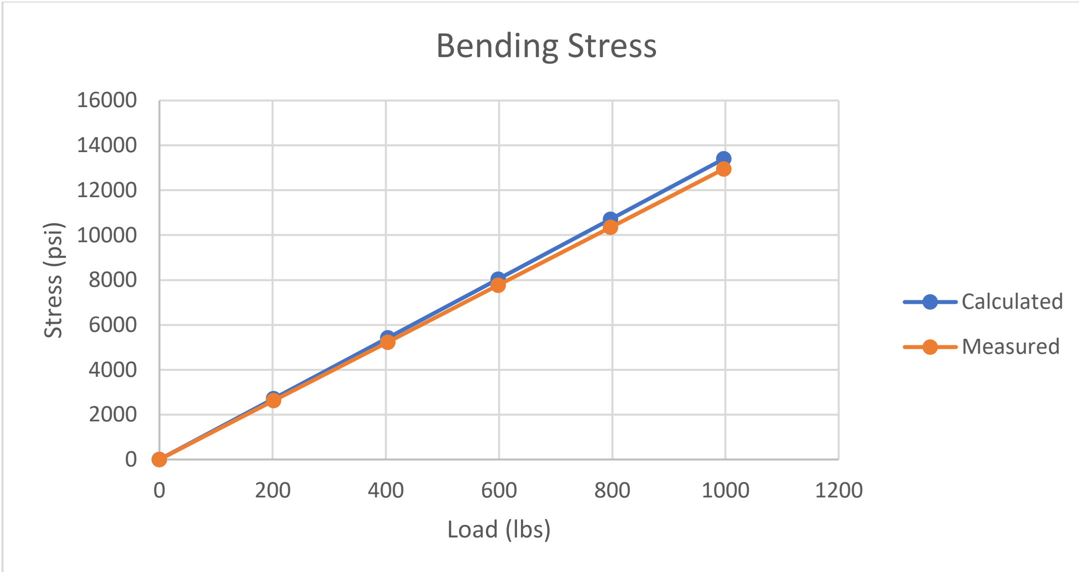
$G =$ Shear Modulus (38000ksi)

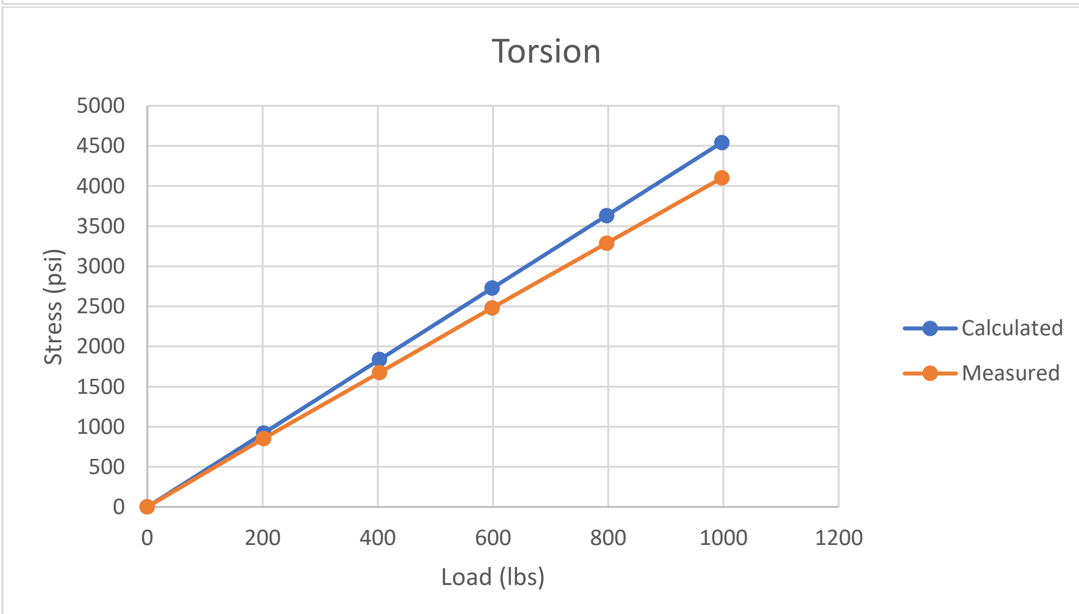
$\gamma =$ Measured Strain

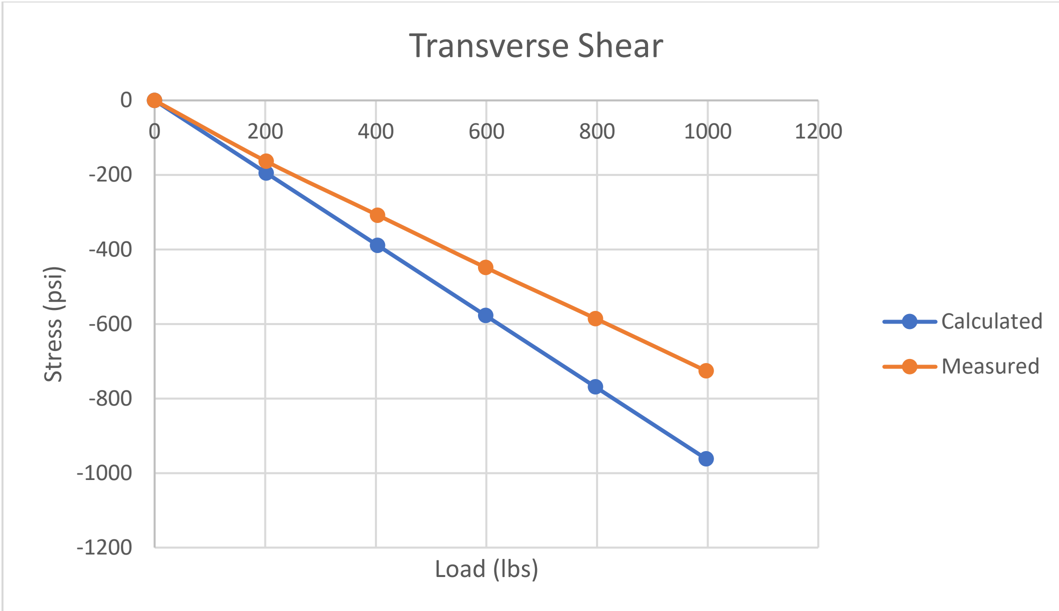
Table of Measured Stress Values

Aplied Load (lbs)	Bending (psi)	Torsion (psi)	Trans Shear (psi)
0	0	0	0
201.67	2623.5	851.2	-163.4
403.19	5227.2	1675.8	-307.8
598.49	7771.5	2481.4	-448.4
797.07	10345.5	3287	-585.2
997.09	12949.2	4100.2	-725.8

d) The graphs of the measured vs. calculated values are shown below.


Bending Stress
16000
14000
12000
10000
8000
6000
4000
2000
0
0
200
400
600
800
1000
1200
Load (lbs)
Stress (psi)
Calculated
Measured


Torsion
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
0
200
400
600
800
1000
1200
Load (lbs)
Stress (psi)
Calculated
Measured



The measured values and calculated values are extremely close meaning that the results from the lab are accurate. This is because the strain gauges are accurate, applied to the specimen correctly, and the blue box used was accurate. The measurements for the dimensions were taken well and the loads were correctly applied. Consistently, the measured value was less than the calculated, this could be due to slight errors in the strain gauge placement and the inconsistencies in the materials.