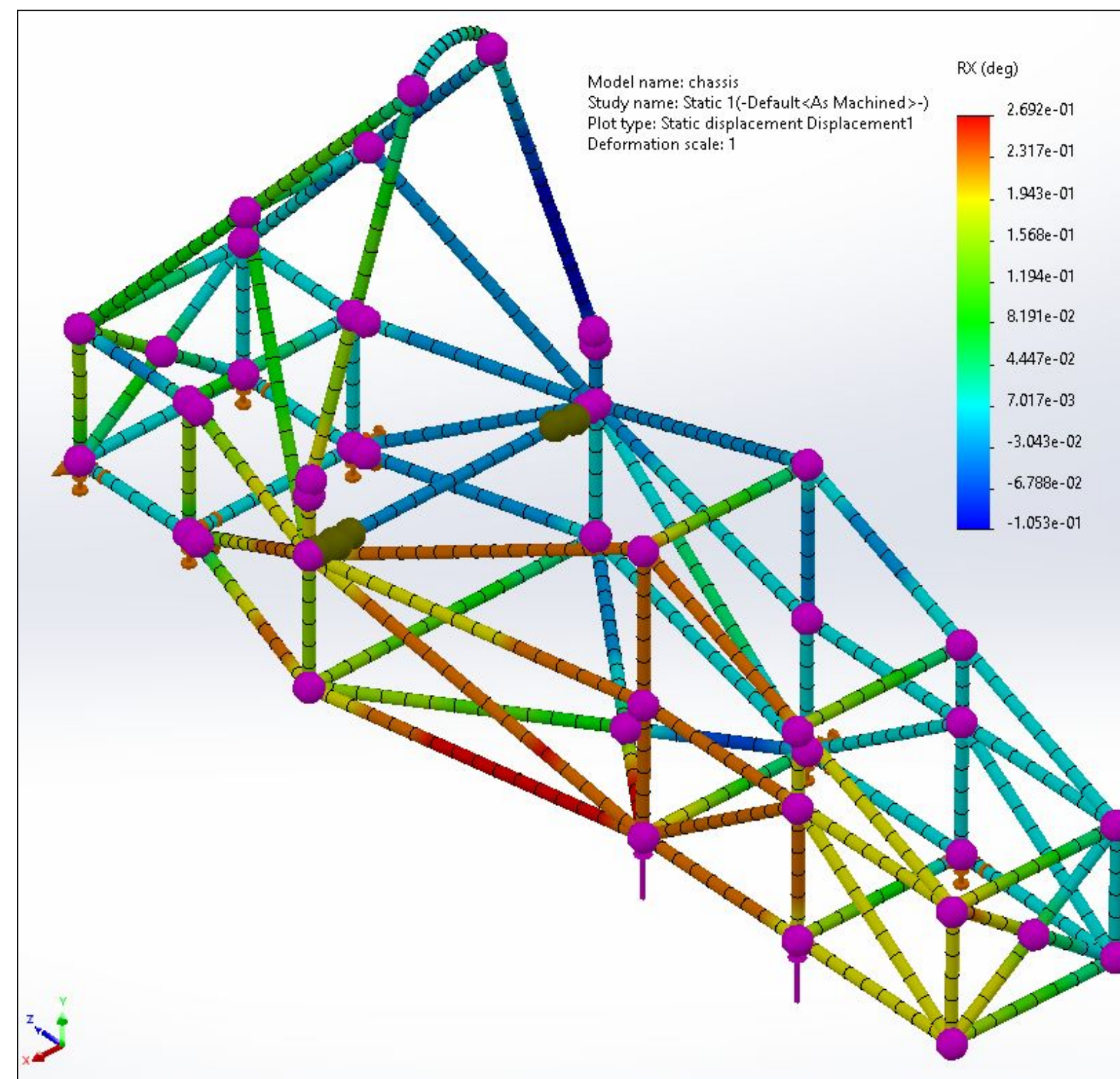


## Analysis:

- Applied a load (4356 N) to one wheel and performed FEA to determine a theoretical torsional rigidity (4237.5 Nm/deg in the vertical axis)
- Potential Failures (Both unlikely)
  - Weld Failure
  - Sleeve Butt Failure



## FORMULA SAE CAR CHASSIS DESIGN AND MANUFACTURING



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Under the supervision of faculty advisers

Prof. K. A. Watson, Prof J. Steimel

Submitted to Department of Mechanical Engineering University of the Pacific



## Project Statement:

To design, build, and test a chassis that will be used in the 2021 SAE Formula Car competition while developing a cheap method of manufacturing.

## Objectives:

To design and build:

- an inexpensive jig that will hold tubing in place within  $\pm 1$  mm and  $\pm 0.5$  degrees and allow for joints to be temporarily welded in order to construct the chassis.
- a chassis that is safe and protects the driver in the case of an accident.
- a chassis that is lightweight (under 80lbs), yet strong enough to withstand the forces of driving (up to 800 lbs).
- a chassis that is capable of fitting a six foot tall driver.

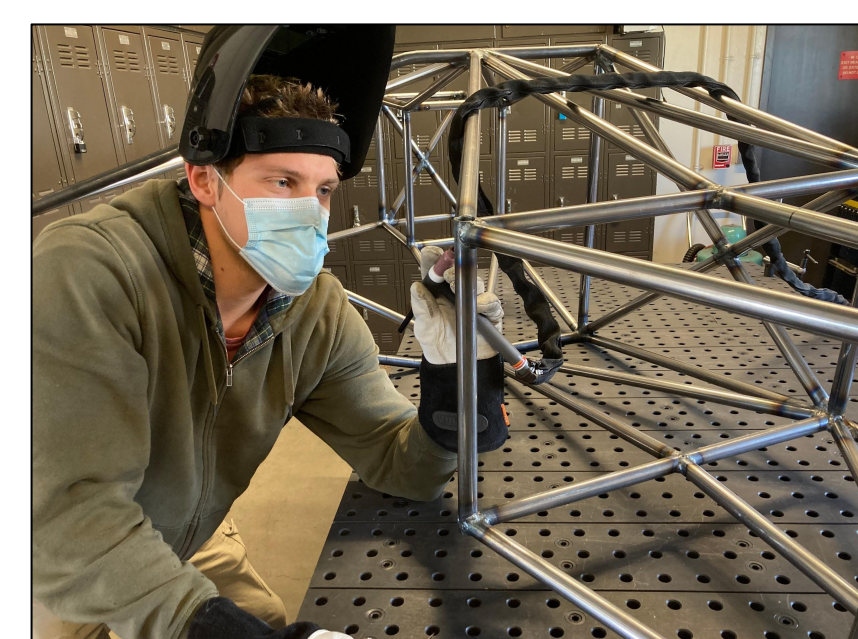
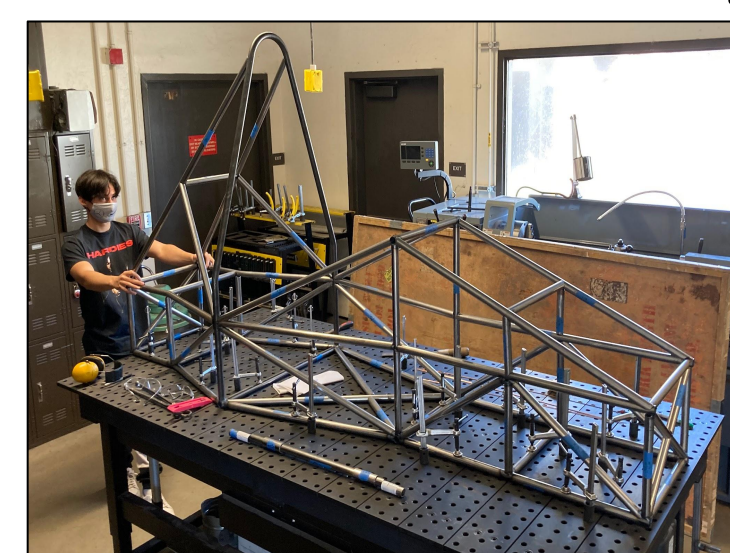
## Testing:

- Chassis weighs 81 lbs
- Torsional rigidity of the chassis was calculated by applying a load to 1 wheel of the chassis and fixing the other 3 and measuring deflection
- Torsional Rigidity = 2927 Nm/deg
- 31% error referencing the FEA
- Difference due to force not being applied in the same location as FEA as well as the deflection being measured at a different point



## Fabrication:

- Jig made from 1005 hot rolled 1" square steel tubing
- Chassis made from 1010 hot-rolled 1" round steel tubing
- Anti Intrusion Plate made from 1010 cold-worked 2'x1'x0.06" steel
- Foam Impact Attenuator from BSCI
- 6061 Aluminum floor riveted to body
- All tubes and plate welded together using GTAW (TIG)
- Used grinders and cutting wheels for fitment
- Used Delta's tube bender for bending



## CAD Drawings and Pictures:

ITEM NO.	PART NAME	QTY.	DESCRIPTION	VENDOR	COST (\$)
1	STOCK ROUND TUBE A	2	1" OD 0.81" ID X 6FT LOW CARBON 1010 HOT ROLLED STEEL USED FOR THE MAIN HOOP AND FRONT HOOP	MCMaster-CARR	16.25
2	STOCK ROUND TUBE A 10FT	1	1" OD 0.81" ID X 10FT LOW CARBON 1010 HOT ROLLED STEEL USED FOR THE MAIN HOOP	MCMaster-CARR	109.36
3	STOCK ROUND TUBE B	23	1" OD 0.87" ID X 6FT LOW CARBON 1010 HOT ROLLED STEEL USED FOR THE FRONT BULK HEAD AND ALL OF THE SUPPORT BRACES	MCMaster-CARR	11.93
4	STOCK TUBE	1	1.25" OD 1" ID X 6.5 LOW CARBON 1010 HOT ROLLED STEEL REMAINING FROM JIG, BUTT JOINT SLEEVE	MCMaster-CARR	0.00
TOTAL					416.25

SCALE 1 : 16

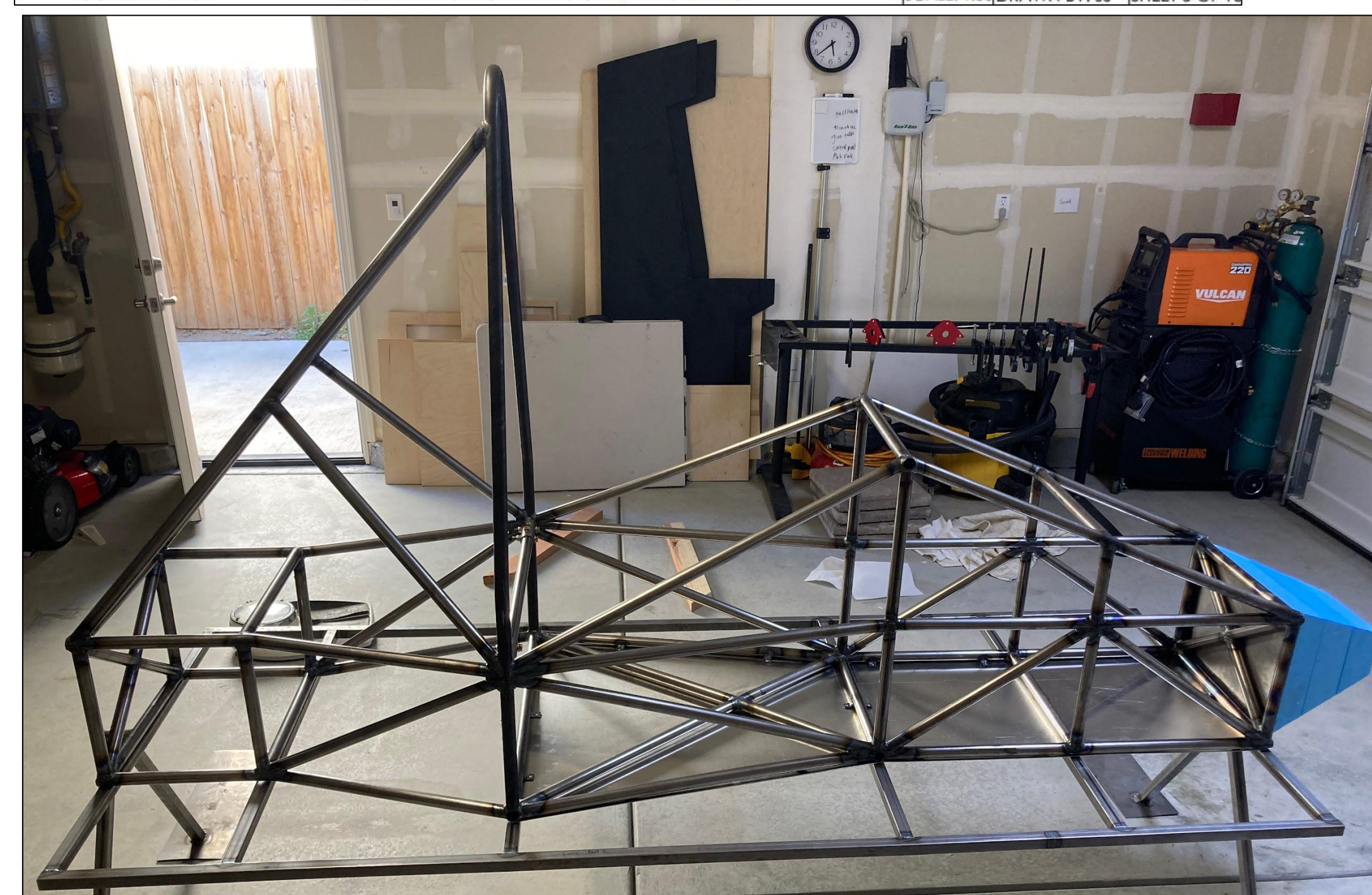
NOTE: IF IT IS NOT BALLOONED IT IS ITEM 3

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ITEM NO.	PART NAME	ASSEMBLY TYPE	QTY.	DESCRIPTION	VENDOR	COST (\$)
1	IMPACT ATTENUATOR (IA)	FINAL ASSEMBLY	1	12" X 14" X 10" IMPAXX 700 FOAM ABSORBS FRONT IMPACT	BSCI ENERGY IMPACT SYSTEMS	170.00
2	ANTI-INTRUSION PLATE (AIP)	FINAL ASSEMBLY	1	12" X 16" X 0.06" STEEL PLATE KEEPS DEBRIS OUT WELDED TO CHASSIS	MCMaster-CARR	26.38
4	U-BOLTS AND NUTS	FINAL ASSEMBLY	12	1" U 2 3/16" LONG BOLT, STEEL HOLDS CHASSIS ON THE JIG	MCMaster-CARR	0.99
3	GLUE	FINAL ASSEMBLY	1	HOLDS IA AND AIP TOGETHER	AMAZON	156.20
5	JIG SUPPORTS	SUBASSEMBLY	1	ALLOWS THE JIG TO ROTATE	FAB. SEE PG. 2	51.30
6	JIG	SUBASSEMBLY	1	HOLDS THE CHASSIS	FAB. SEE PG. 3	124.13
7	CHASSIS	SUBASSEMBLY	1	FRAME FOR THE FSAE CAR	FAB. SEE PG. 6	416.25
TOTAL						956.14

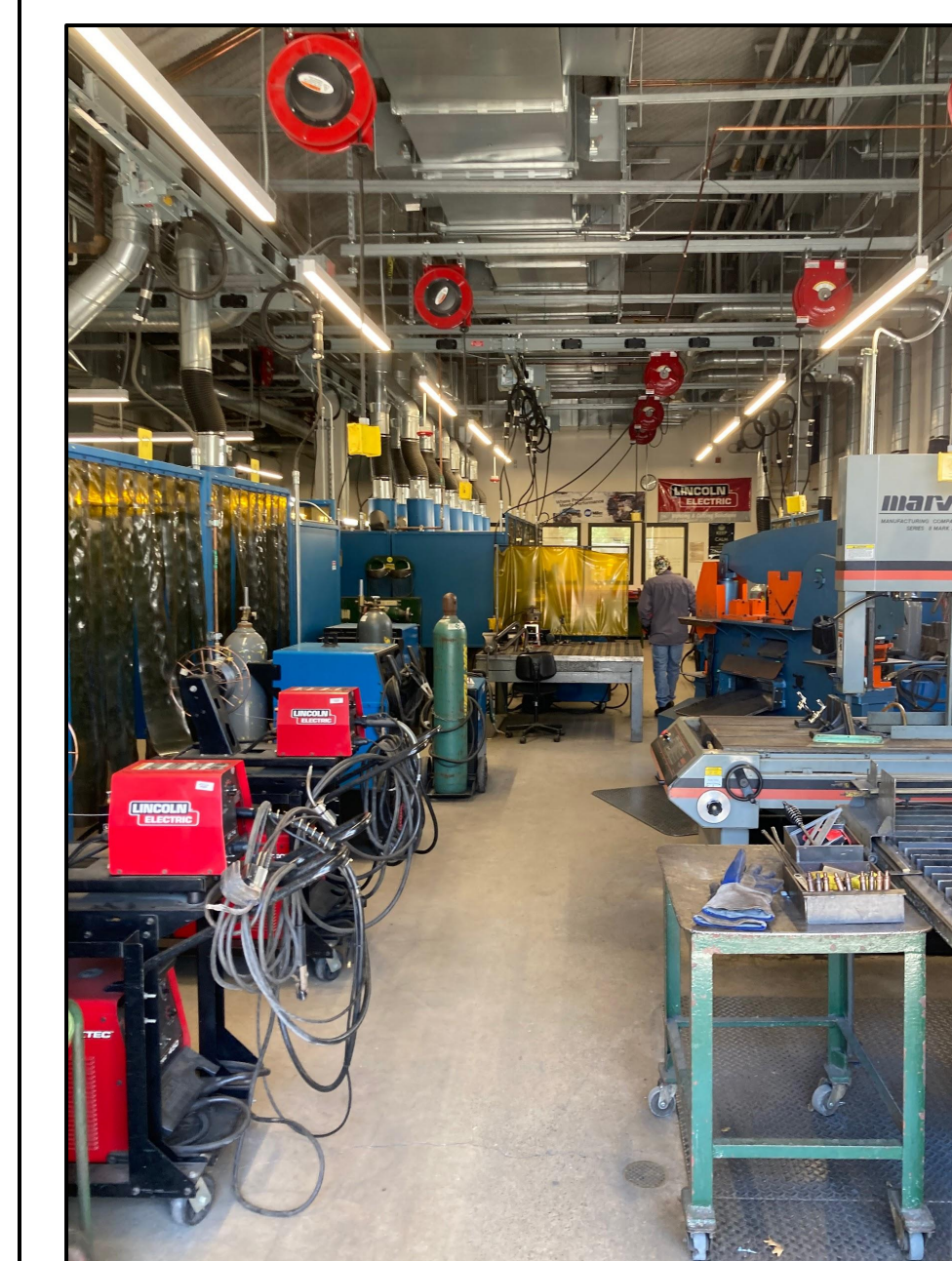
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## Covid-19 Impact:

- Bending & welding performed at Delta
- Longer shipping times
- UOP campus accessibility limited
- Zoom Meetings
- The FSAE competition all online
- Testing limited



## Special Thanks:

Professor Alex Taddie (SJDC),  
UOP Department of Engineering