

# Aztec Electric Racing Chassis



Team Members: (Top) Cameron Curet, Brandon Black (Bottom) Jarod Dias, Emily Bidgood, Carmen Marquez

Team Totally Tubular Project: 32, Team: F11

## Problem Statement:

AER cannot use last year's chassis to compete at 2020 FSAE Electric competition. The team wastes time and resources researching and iterating the vehicle each year when there is no documentation from prior years' efforts. The current chassis on the 2019 Aztec Electric Racing (AER) vehicle is vaguely documented, not analyzed, and constructed in a complex, difficult-to-use Solidworks file.

## Need:

AER's chassis frame needs to be 100% remanufactured. The team would benefit from clear, detailed documentation which follows the new AER-20 chassis from concept to competition. This will ensure effective knowledge transfer to future generations of the AER team, including any changes to existing mounting points or tube members.

## Sponsor:

Aztec Electric Racing (AER) is a Formula Society of Automotive Engineering (FSAE) club on campus. Designs an open wheel single person electric race car to compete in FSAE design and race competition.

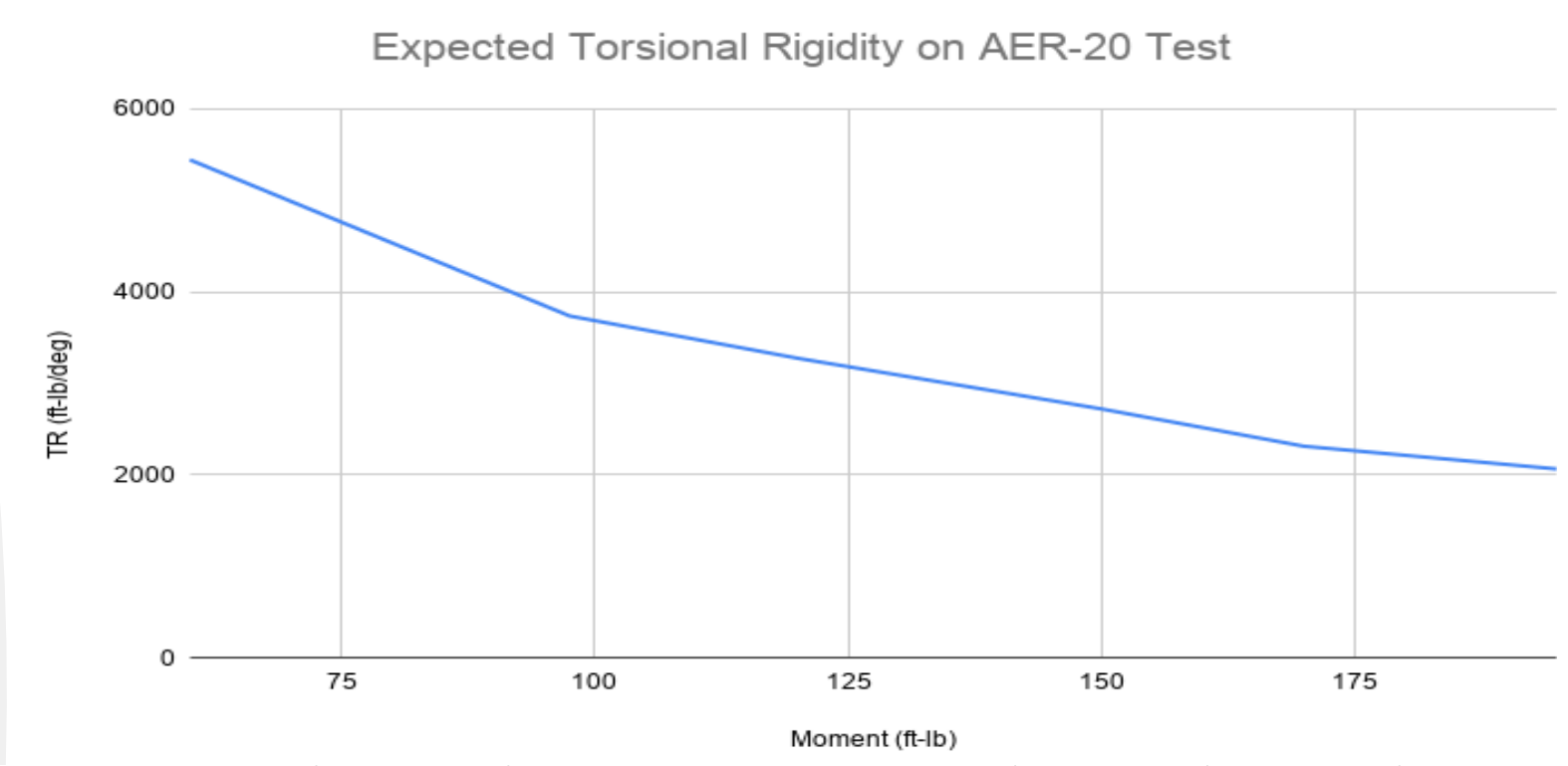
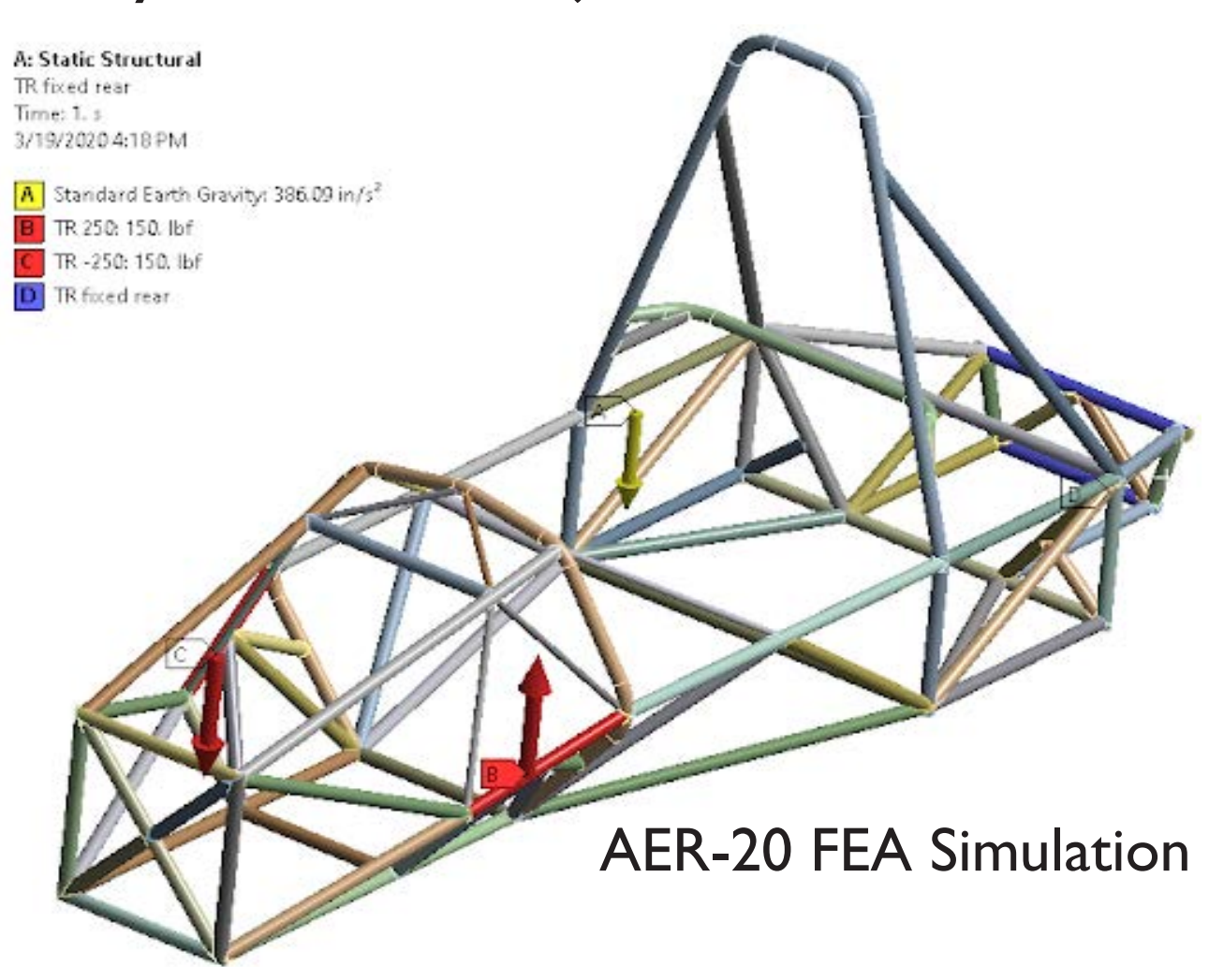
## Requirements

- Meet 2020 FSAE Rules (120+)
- Chassis must support 700lbs
- Accomodate suspension hardpoints
- Provide entire car component integration
- Select and purchase a durable fixture table for AER
- Documentation of Design, Analysis, and Manufacturing of chassis
- Fixtures must be 25% reusable
- \$8,000 Budget



## Analysis and Testing

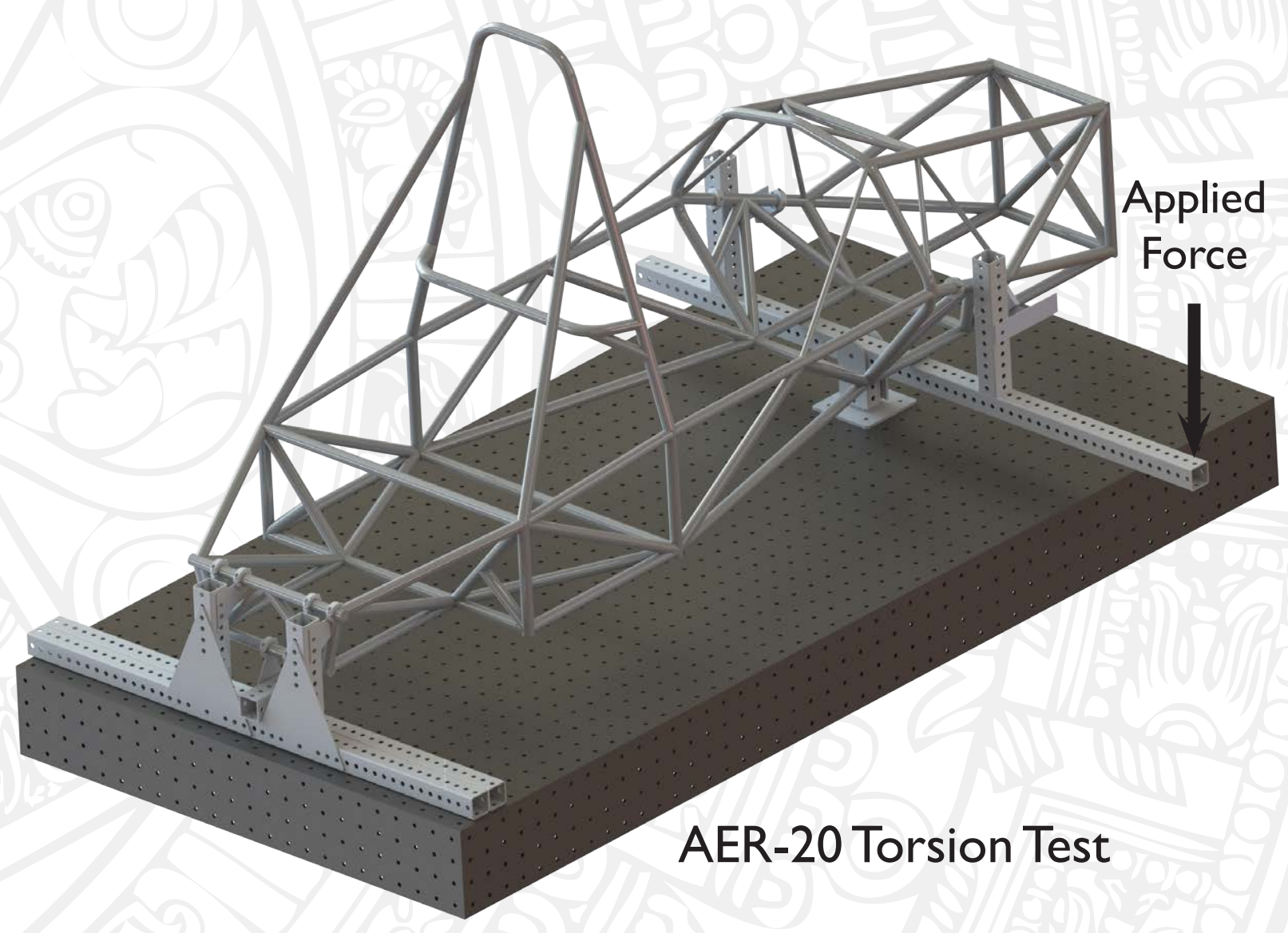
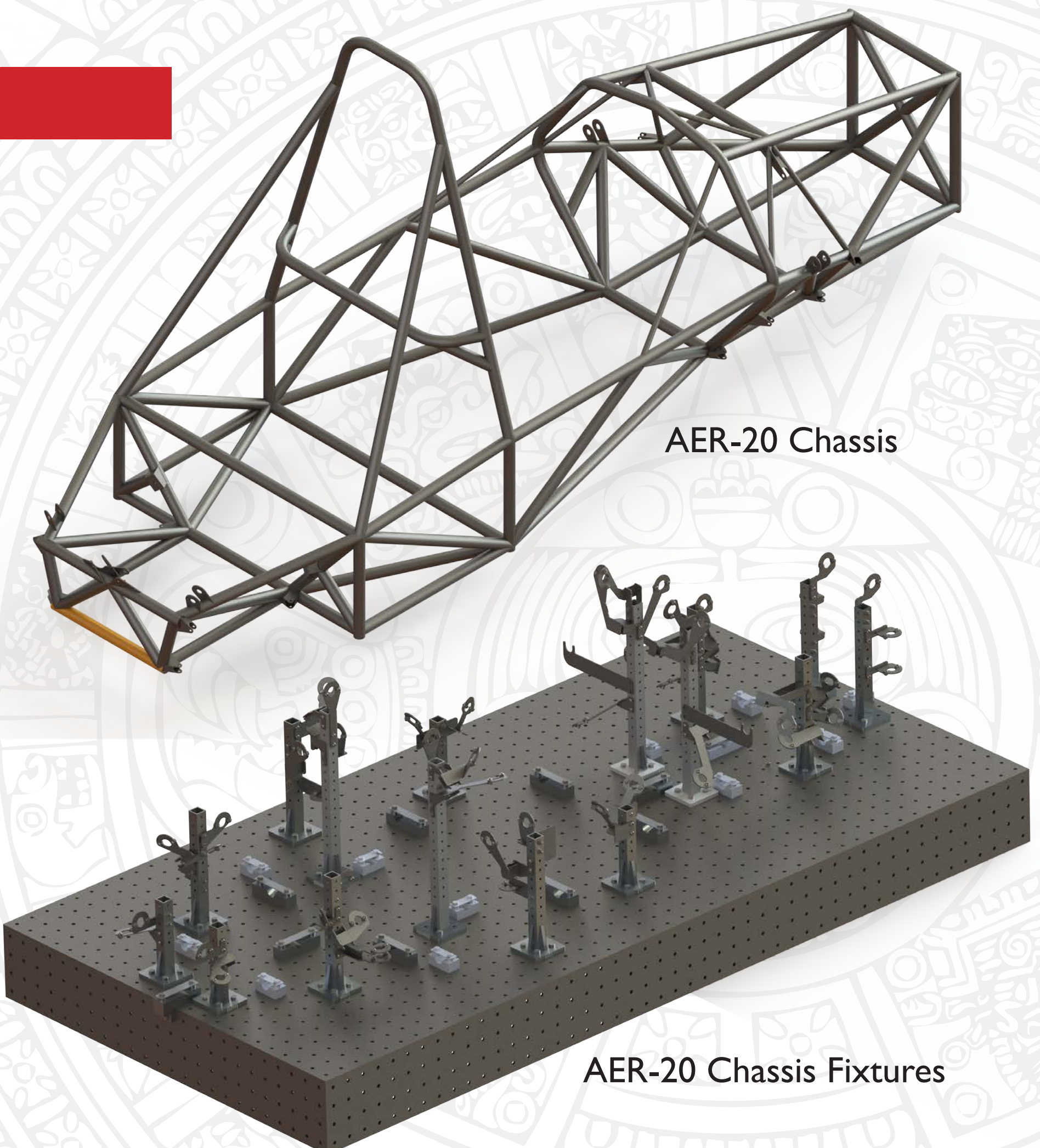
- Torsional Rigidity of 2,450 ft-lb/deg at highest loading scenario
- Maximum moment of 170 ft-lbs applied, about the roll center, from suspension
- FEA Simulation represents realistic scenario with fixed rear trapezoid (purple) of the chassis and a couple moment on the front belcrank (red) tubes
- FEA Simulation can be accurately tested by our proposed test fixture (below). This can prove confidence in FEA going forward
- Proposed Test Fixture costs \$398.67



## Design

### Chassis: The supporting frame and envelope of a motor vehicle

- TIG welded 4130 Chromoly Steel Spaceframe Chassis
- Primary envelope features Front Bulkhead, Front Roll Hoop, Side Impact Structure, and Main Roll Hoop
- Proper triangulation ensures load cases are transferred into tension and compression
- Integrates all supporting systems and takes on various load cases from braking cornering, and accelerating
- Extra room behind driver to accomodate large energy storage unit



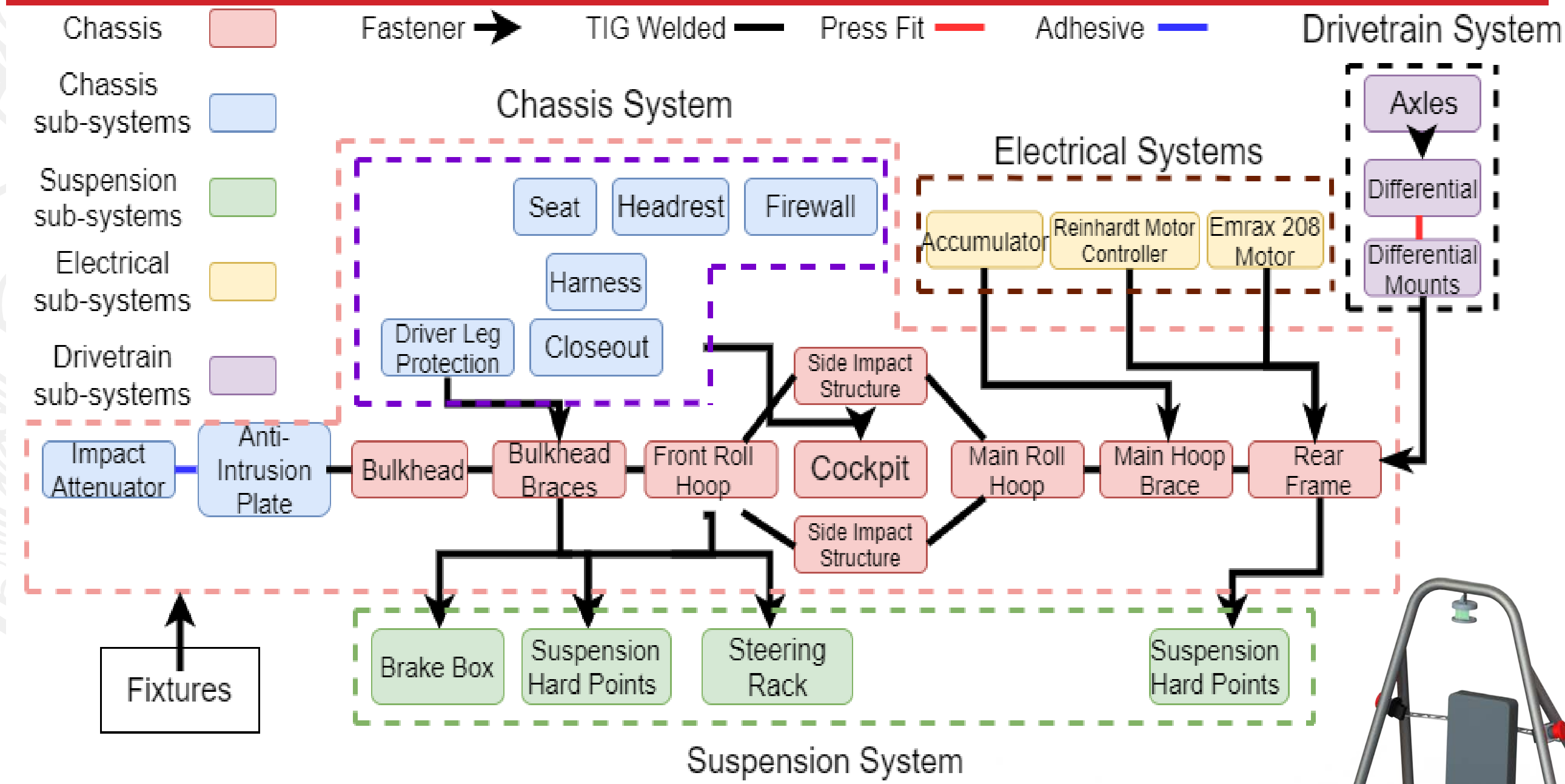
### Fixtures: Equipment to hold pieces in fixed positions while fabricating

- Fixture table dimensions: 4'x8' with 3/8-16" tapped holes
- 1/4" thick hot rolled pickled and oiled steel table with legs
- Designed to be 60% reusable
- Constrain chassis tubes from movement while being welded
- 16 perforated aluminum towers provide various heights for fixture arms
- 46 steel fixture arms and clasps utilized to match thermal dissipation of welding while keeping tube members in place
- 21 aluminum U-block constrains lowest tube members

Name	Quantity	Specifications	Material	Source	Cost
Rear Torsion Fixture Base	2	4" Bolt Together Framing 2"x2"	Steel		
Rear Torsion Fixture Tower	2	10" Bolt Together Framing 2"x2"	Steel		
Bottom Torsion Fixture Brace	1	5" Bolt Together Framing 2"x2"	Steel	McMaster-Carr	\$158.02
Front Lever Arm	1	5" Bolt Together Framing 2"x2"	Steel		
Front Torsion Fixture Tower	2	12" Bolt Together Framing 2"x2"	Steel		
Pivot Tower	1	3.5" Bolt Together Framing 2"x2"	Steel		
Pivot Base Plate	1	Steel Sheet Metal 1/4" thickness	Steel	McMaster-Carr	\$73.50
Collar Clamp	10	1" ID 1.75" OD Steel	Steel	Zoro	\$28.55
Rear Triangle Tower Support	2	1"x1" Steel Sheet Metal 1/8" thickness	Steel	IMS	\$40.00
Fixture Bridges	10	2"x2" Steel Sheet Metal 1/8" thickness	Steel	IMS	\$74.00
Dial Indicators	2	1-3/16" white face	Stainless Steel	Turley	\$74.00
Fastener	30	Grade 5 Steel Hex 3/8"-16 shoulder bolts	Steel	McMaster-Carr	\$24.00
<b>Total</b>					<b>\$398.67</b>

Name	Quantity	Specifications	Material	Source	Cost
Chassis Tubes	80	1" OD wall thickness .055"-.095"	4130 Chromoly	Creo Industries	\$1,980.00
End Caps	10	Sheet metal 1' x 1' thickness 0.065"	Steel	Shop Yard	\$0.00
Spacers	4	Sheet metal 1' x 1' thickness 0.065"	Steel	Shop Yard	\$0.00
Fixture Table	1	4'x8' table with 3/8-16 tapped holes	HRPO Steel	Certiflat	\$3,842.69
Tube Clamps	21	Solid Al billet scrap block	6061 Aluminum	IMS	\$60.12
Short Tower	4	height 8" - 1.25" x 1.25" square tubing thickness 1/8"	6063 Aluminum	IMS	\$88.94
Standard Tower	8	height 12" - 1.25" x 1.25" square tubing thickness 1/8"	6063 Aluminum	IMS	\$88.94
Tall Tower	4	height 18" - 1.25" x 1.25" square tubing thickness 1/8"	6063 Aluminum	IMS	\$88.94
Base Plate	16	Sheet metal 0.6" thickness	6063 Aluminum	IMS	\$103.62
Standard Gusset	32	Sheet metal 0.6" thickness	6063 Aluminum	IMS	\$103.62
Fixture Part	120	Sheet metal .125" thickness	Steel	McMaster Carr	\$164.40
Clasp	46	Sheet metal .125" thickness	Steel	McMaster Carr	\$164.40
Tube Clamp Fastener	100	Grade 5 steel hex 3/8"-16 shoulder bolts	Steel	McMaster Carr	\$97.40
Base Plate Fastener	100	Grade 5 Steel Hex 3/8"-16 Thread Size, 1" Long	Steel	McMaster Carr	\$97.40
Tower Arm Fastener	125	Black oxide solid steel 1/4"-28 bolt, 1-3/4" Long	Steel	McMaster Carr	\$97.40
Clasp Fastener	200	Black oxide solid steel 1/4"-28 bolt, 1/2" Long	Steel	McMaster Carr	\$97.40
123 Blocks	2	1"x 2"x 3" block with 5/8" holes	Steel	All Industrial Tool Supply	\$25.00
PC-7 Epoxy	1	Cement-like 2 part epoxy for towers	Epoxy	Amazon	\$18.00
Flex Drill Extender	1	8" Ryobi extender	Steel	Amentee Brand LLC	\$10.00
Welder	1	Dynasty 210 Welder	Various		\$0.00
Welding Screens	3	6"x6" Red sceens with Al frame	Plastic/Aluminum	Praxair	\$225.00
Scotch Brite	6	6"x 9" green square	Scotch Brite	AER	\$0.00
Acetone	1	1 Gallon	Acetone	Home Depot	\$17.00
C-Clamps	3	Clamp sizes 1", 2", 3"	Steel	Harbor Freight	\$25.00
Protractor	1	Husky Digital Protractor	Steel	Home Depot	\$20
<b>Total</b>					<b>\$6,677.17</b>

## System Level Diagram

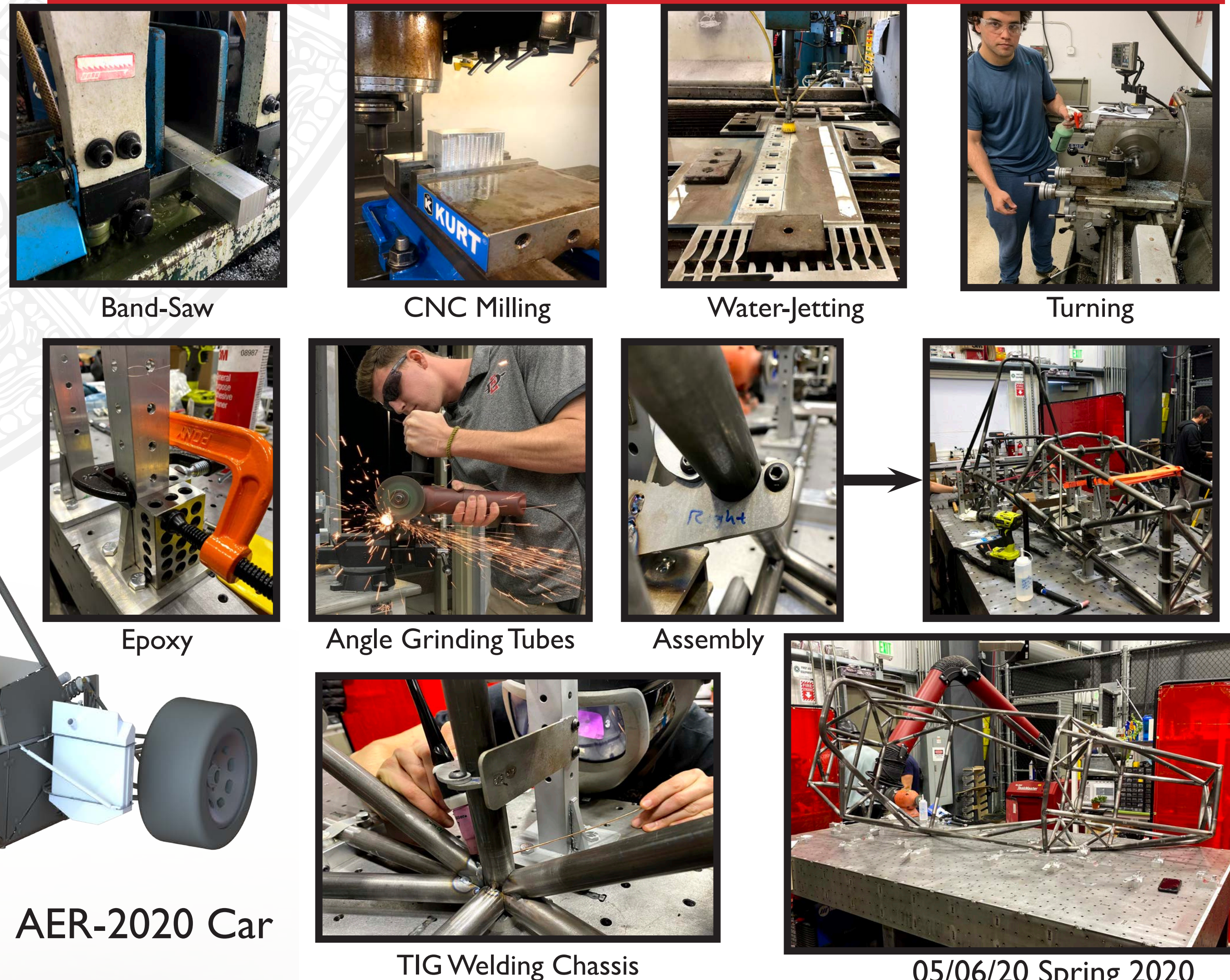


## System Specifications

- Weight: 72lbs
- Material: 4130 Chromoly
- Filler Rod: ER70S-2
- Tubes Used: 80
- Weld Time: 56 hours
- Torsional Rigidity: 2,450 ft-lb/deg
- Dimensions: 93.5"x29"x43"



## Fabrication



05/06/20 Spring 2020