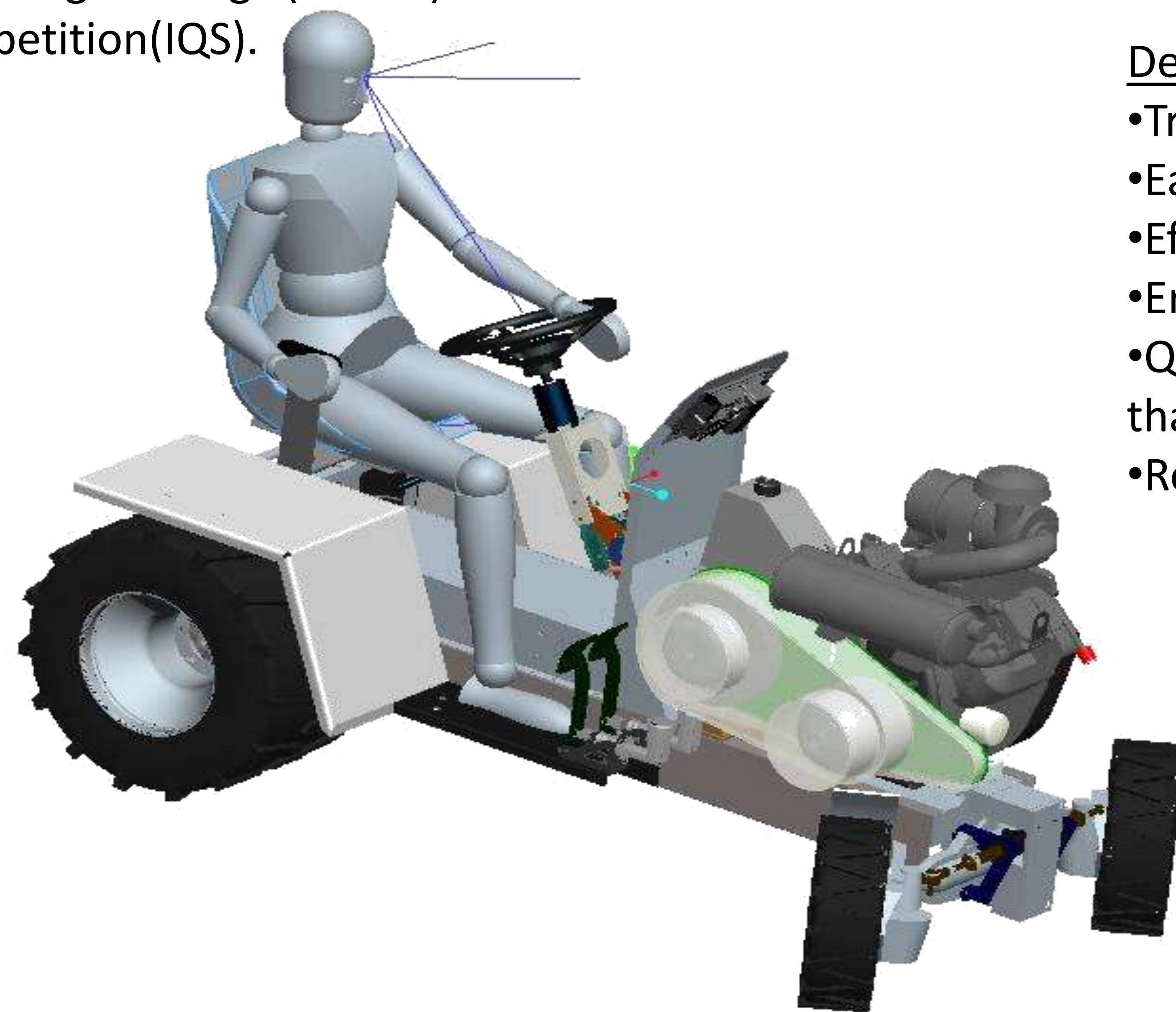


Randy Eckel (MSE), Wayne Jeffers (MSE), Grant White (MSE), Mike Lee (ASM), Daniel Butler (MSE)

Problem statement:

The goal of the project is to design, fabricate, and test a frame, drive train, operator station, electronics system, and exhaust for the quarter scale pulling tractor that meets all the rules and regulations of the American Society of Agricultural and Biological Engineering (ASABE) 2011 International Quarter Scale competition(IQS).



PQSo11- Designed with the operator in mind

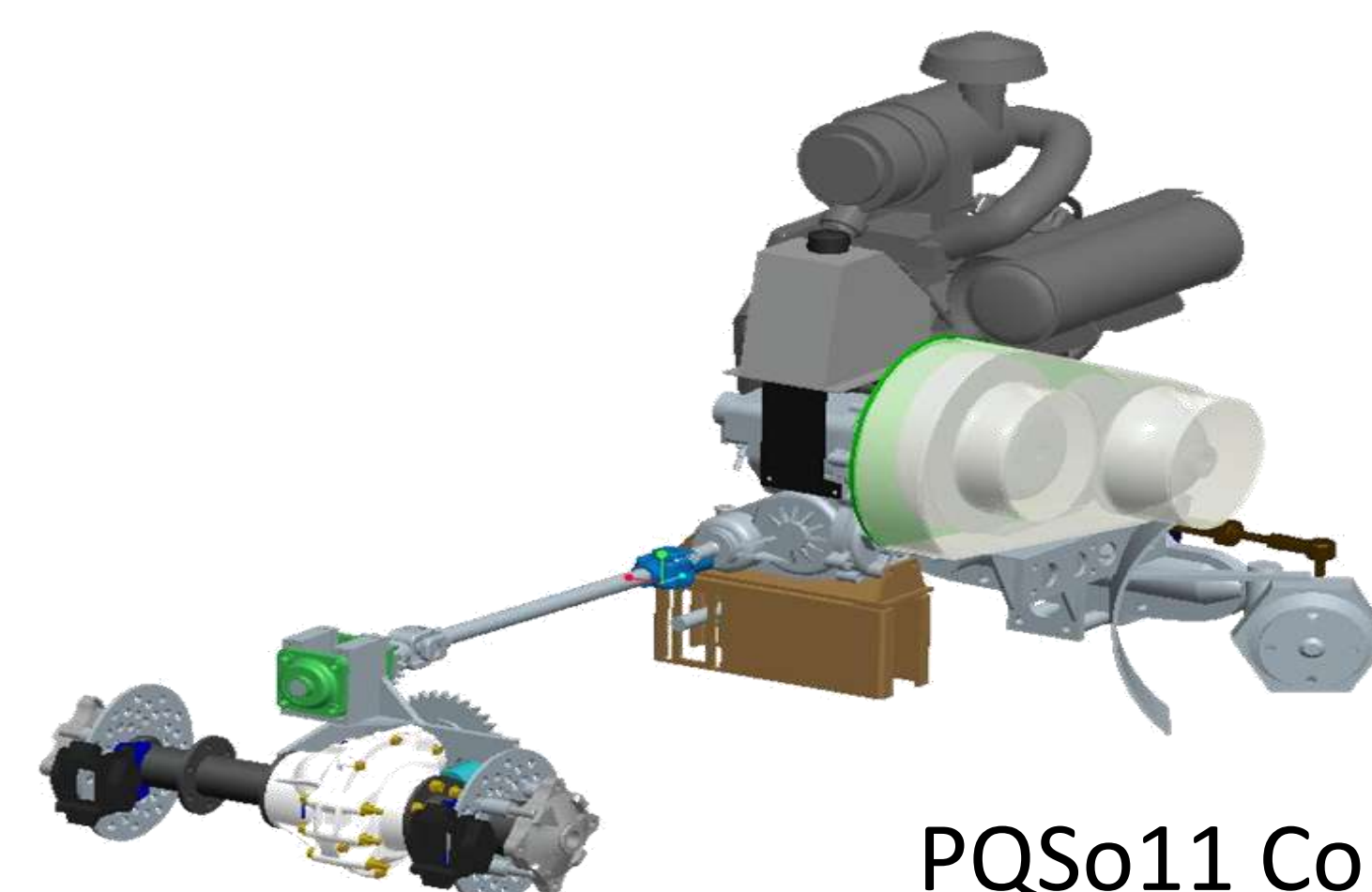
Design Objectives:

- Tractor weight under 800 lbs
- Easily manufactured frame
- Efficient, dependable drivetrain
- Ergonomic operator's station
- Quiet (less than 91dB), lightweight (less than 25 lbs) exhaust
- Reliable electronics

Cost Breakdown Summary

	Category	Purchased	Fabricated	Overhead	Total Cost
1	Engine System	\$ 1,765.43	\$ -	\$ -	\$ 1,765.43
2	Transmission/Transaxle	\$ 2,000.00	\$ -	\$ -	\$ 2,000.00
3	Drive train	\$ 35.04	\$ 243.43	\$ -	\$ 659.47
4	Tires & Wheels	\$ 21.53	\$ -	\$ -	\$ 421.53
5	Steering	\$ 21.13	\$ 136.23	\$ -	\$ 445.36
6	Frame	\$ -	\$ 452.92	\$ -	\$ 548.92
7	Body	\$ 65.23	\$ 24.62	\$ -	\$ 244.39
8	Brake System	\$ 205.49	\$ 6.88	\$ -	\$ 212.37
9	Electrical System	\$ 48.67	\$ -	\$ -	\$ 148.67
13	Miscellaneous	\$ 22.74	\$ -	\$ -	\$ 22.74
14	Final Assembly	N/A	\$ 68.23	\$ 40.00	\$ 108.23
TOTAL		\$ 4,185.26	\$ 932.31		\$ 6,577.11

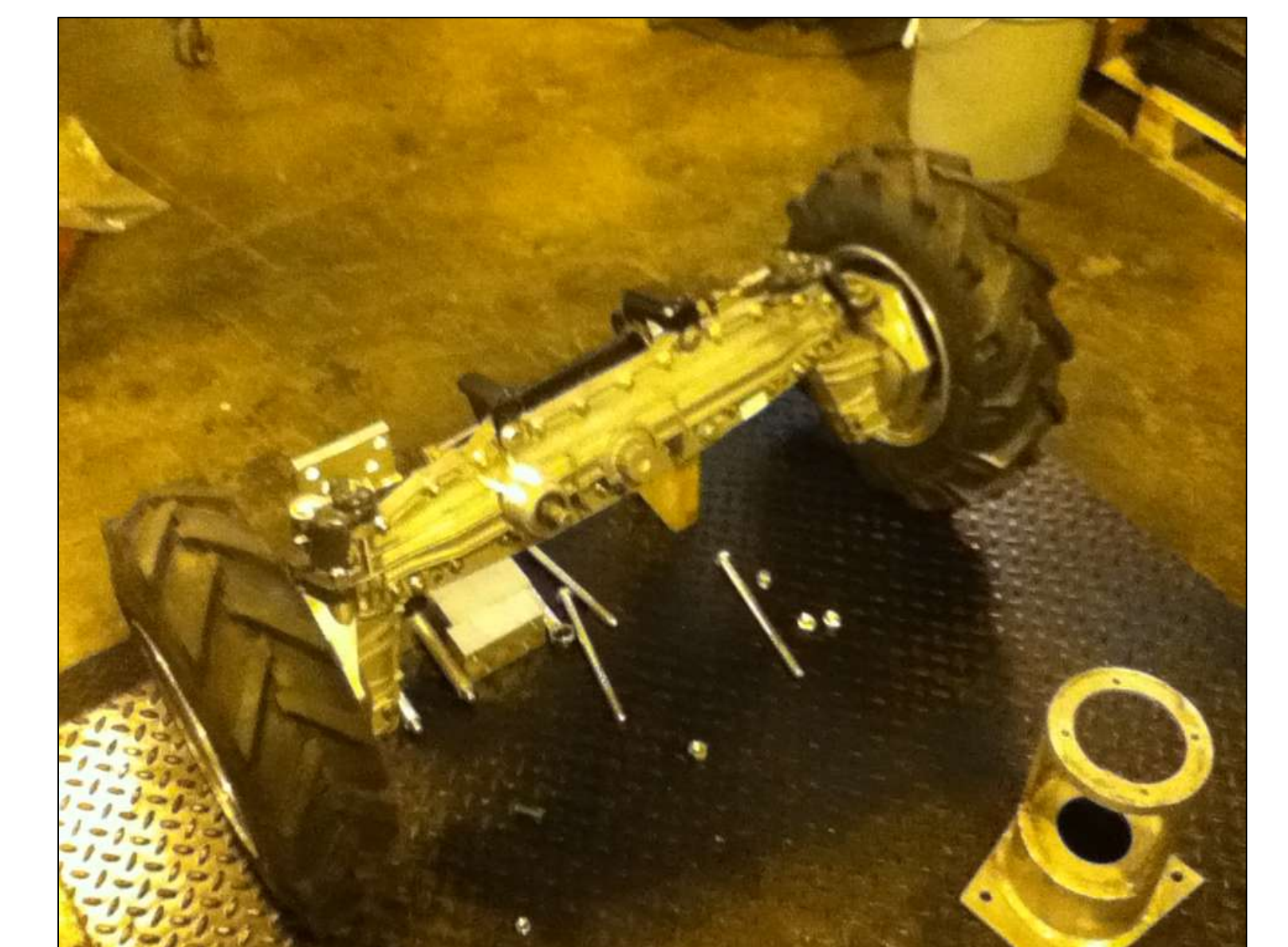
Drivetrain



PQSo11 Complete
Drivetrain Assembly

Objectives

- Drive train under 500 lbs
- Must be efficient in order to deliver maximum power to the drive wheels
- A functional drivetrain system that meets the performance and safety needs of competition.



Front Drive Axle

Design Tools

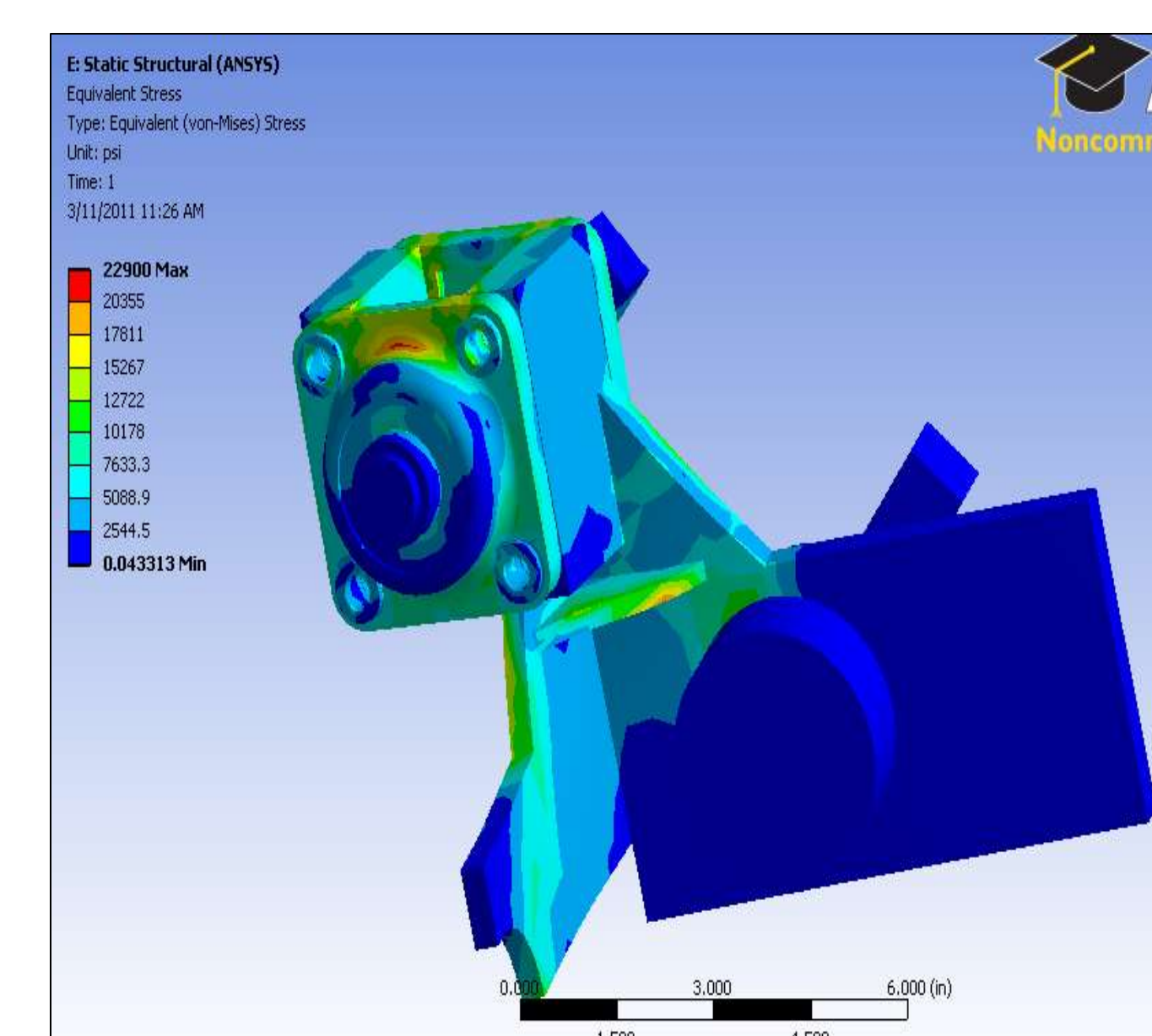
- Pro/Engineer – Used for 3-D modeling of tractor
- Excel – Design matrix & calculations
- ANSYS – Finite Element Analysis (FEA) of components

	2-eng, 2wd	1-eng, 2wd	1-eng, 4wd
Performance	1	3	5
Weight	2	5	4
Cost	2	5	4
Manufacturability	2	5	4
Serviceability	3	5	4
Ergonomics	1	3	5
Customer Satisfaction	2	1	5
Total	13	27	31

Drivetrain Layout Design Matrix



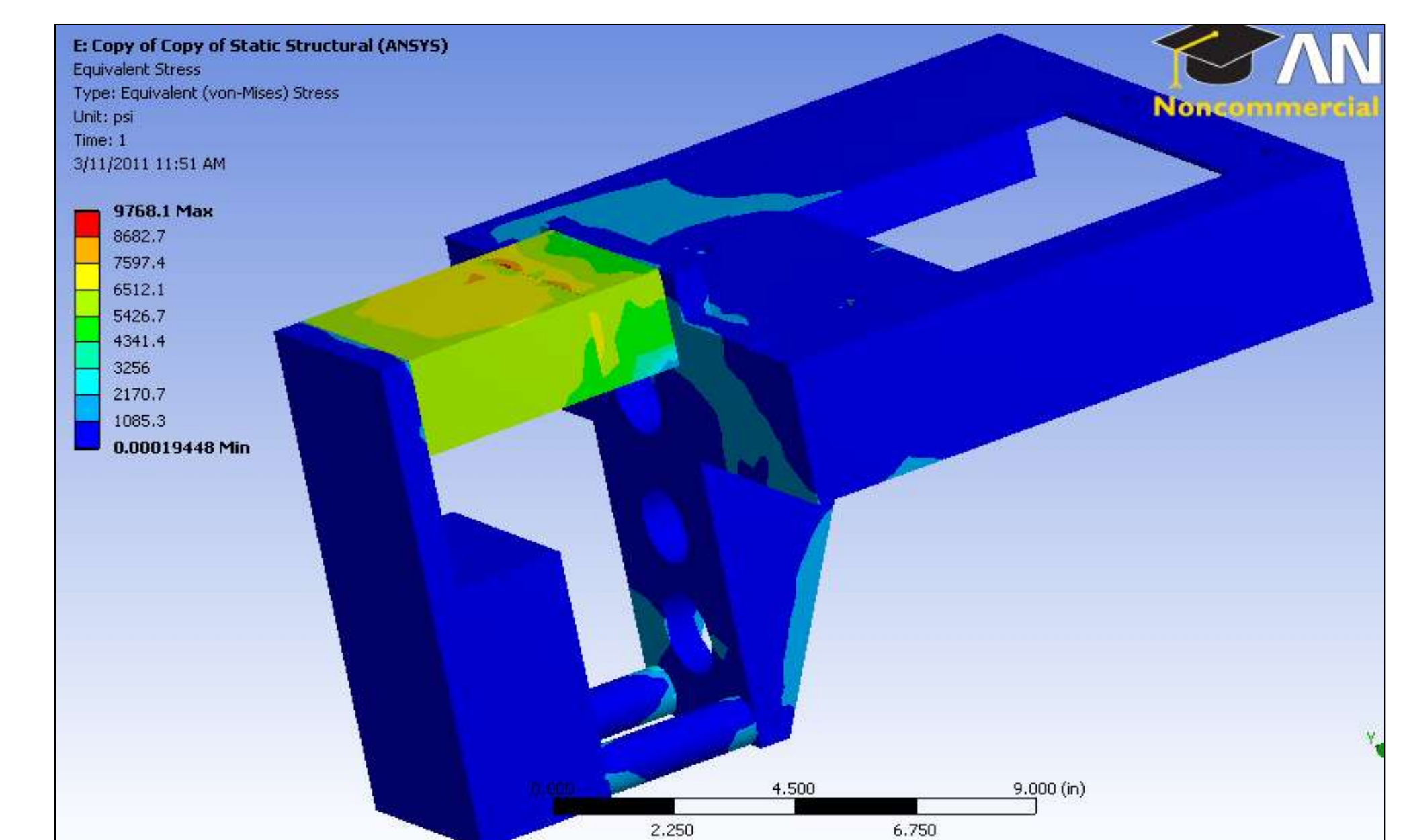
CVT implemented on PQSo11



Rear Chain Support

Implementation

- Use CVT in order to help with track variation
- Chain assemblies were used to transfer power to drive axle
- Implement a front drive axle from a Kubota front end.
- Polaris Differential was used for the rear drive axle
- A Polaris transmission was used to separate power to both drive axles
- Weight: 482 lbs



Front Axle Support

Sponsor: Dr. John Lumkes
Technical Advisor: Michael Holland

Special thanks:
Dr. Bernie Engel
Scott Brand
Garry Williams
John Andrich
Kyle Brooks



Randy Eckel (MSE), Wayne Jeffers (MSE), Grant White (MSE), Mike Lee (ASM), Daniel Butler (MSE)

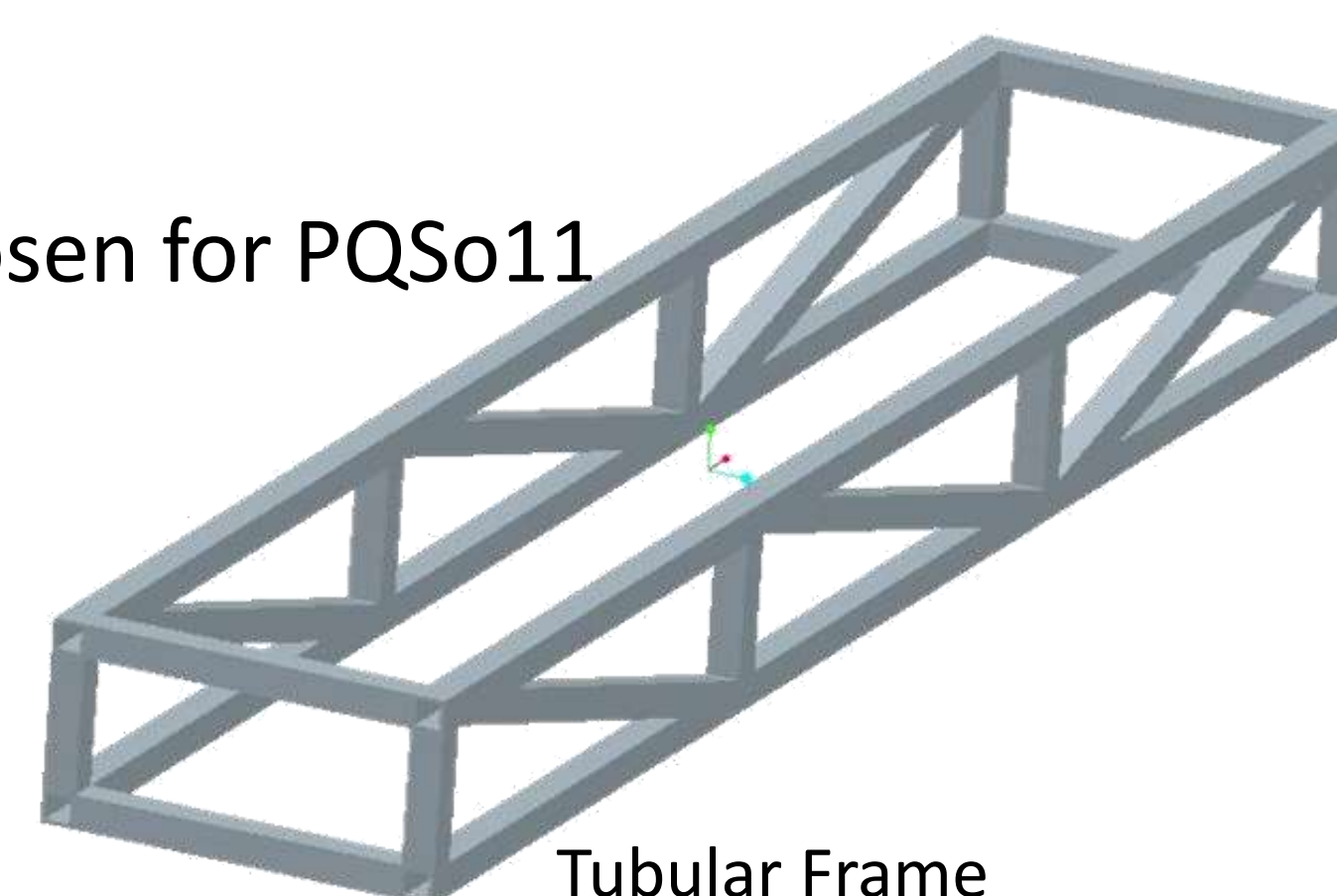
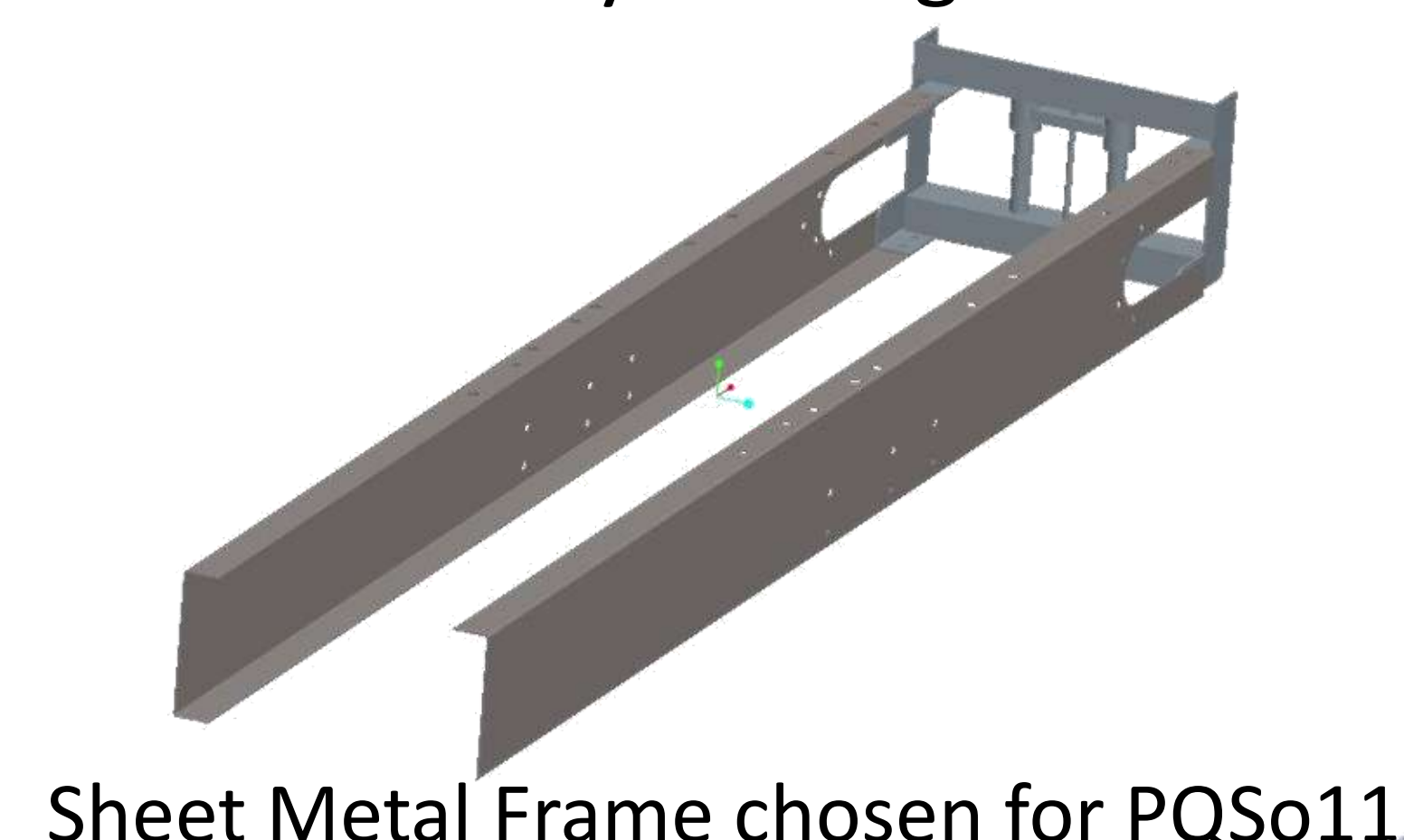
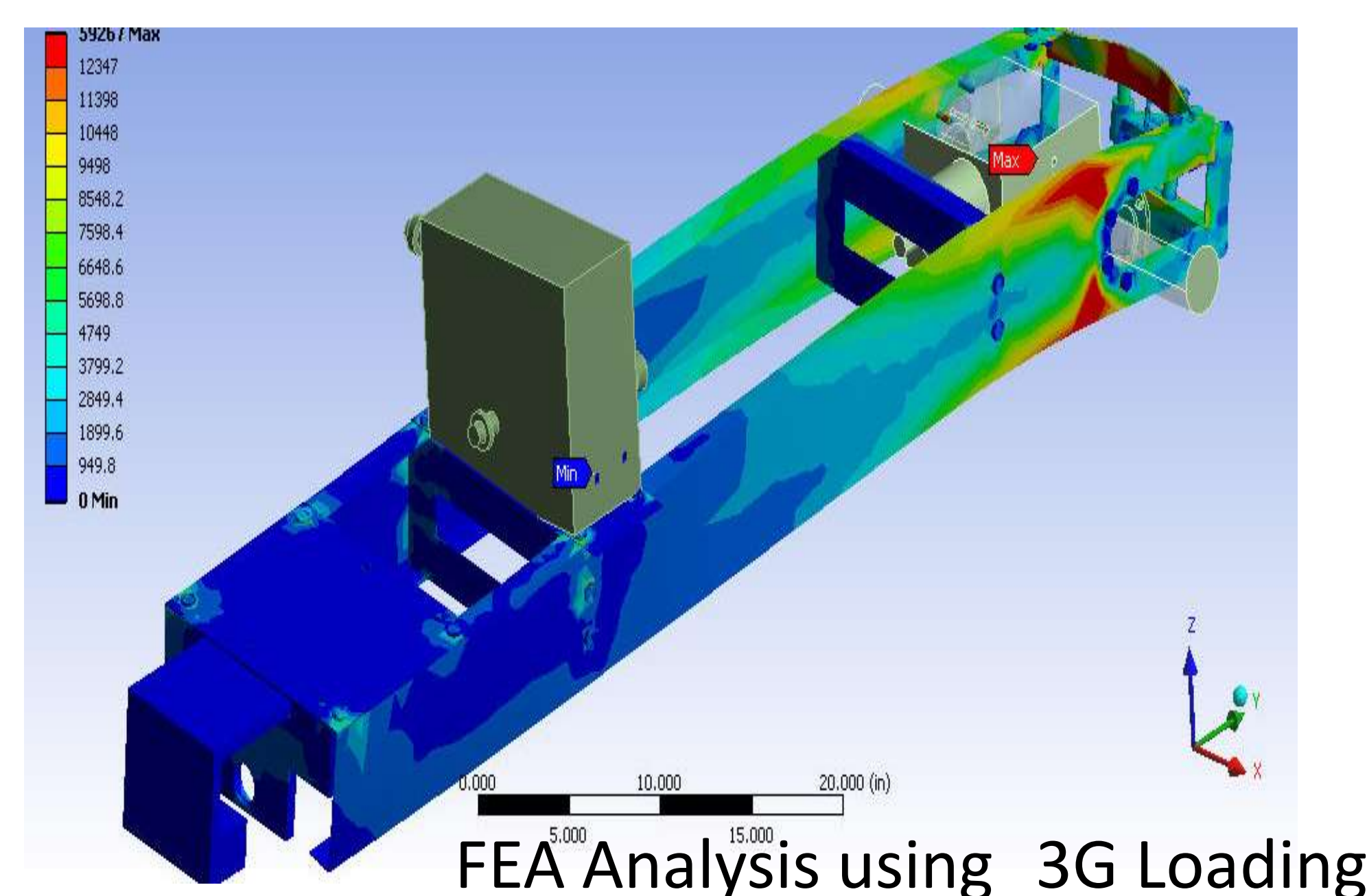
Frame

Objectives

- Frame under 50 lbs to allocate more weight for ballasting
- Easily manufactured components
- Rigid structure to support other sub-assemblies
- Model concepts in Pro/E with ANSYS verification

Implementation

- Thin gauge bent sheet metal was used
- CNC produced parts decreases assembly time
- The FEA analysis verification showed 1300psi von misses stress
- All three frame designs are shown to the right



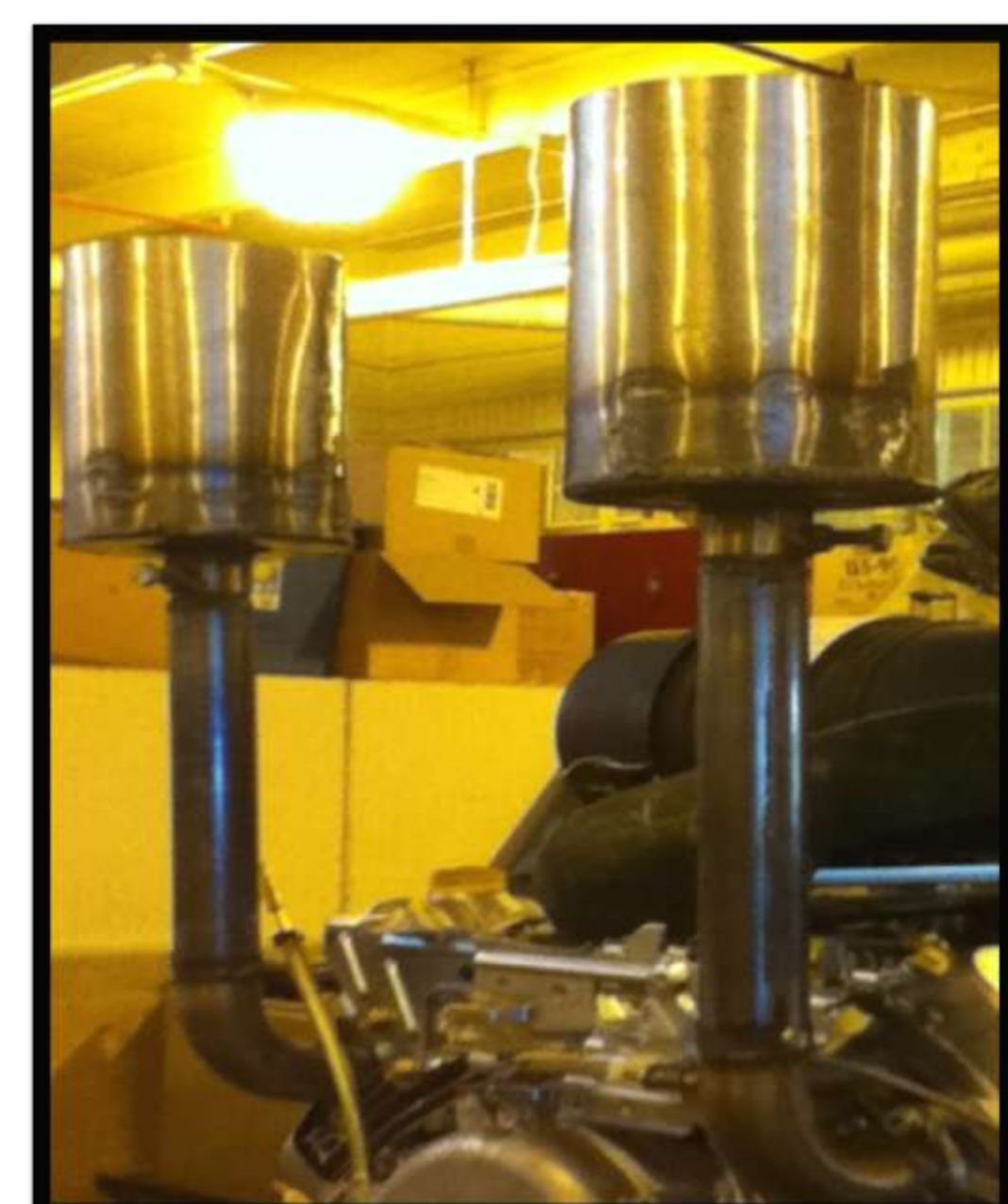
Exhaust

Objectives

- Design an exhaust system that produces less than 91 dB with minimal power loss
- Keep in mind ease of manufacturability during design
- Develop heat shield for operator safety

Implementation

- Constructed 3 different systems with the quietest system being implemented.
- Utilizes a production tractor muffler for ease of manufacturability
- The final system produced 85 dB.
- Constructed a shield from lightweight aluminum and expanded metal to ensure operator safety

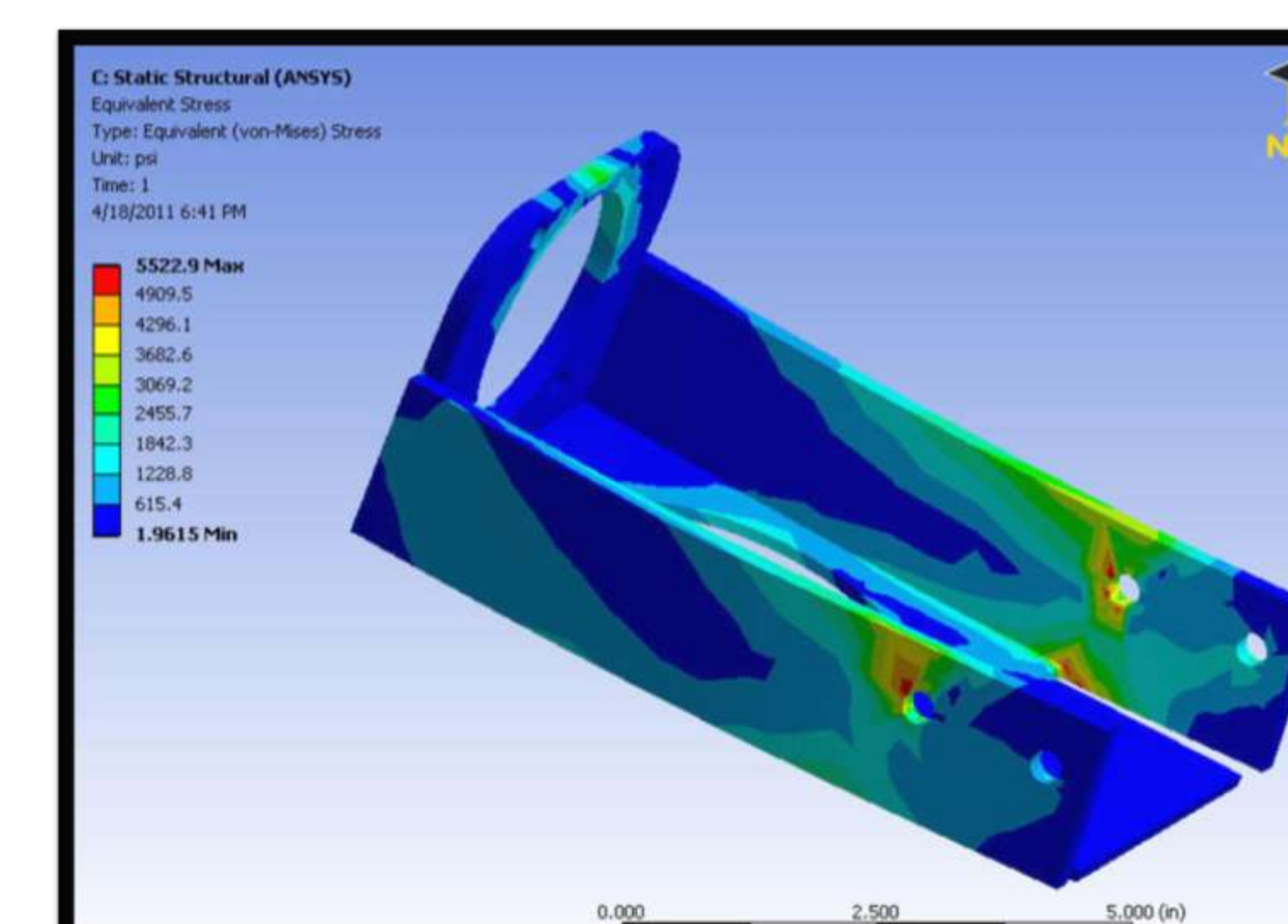
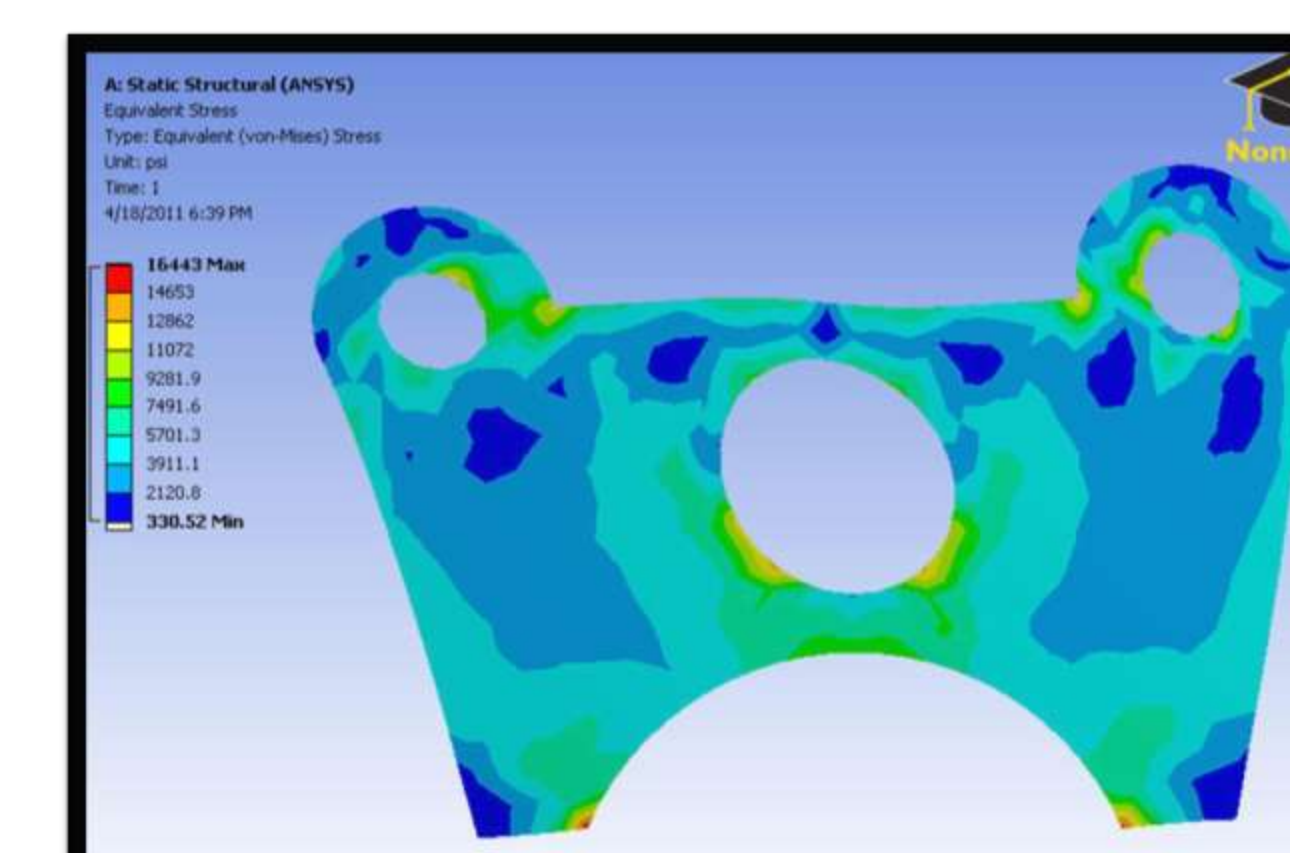
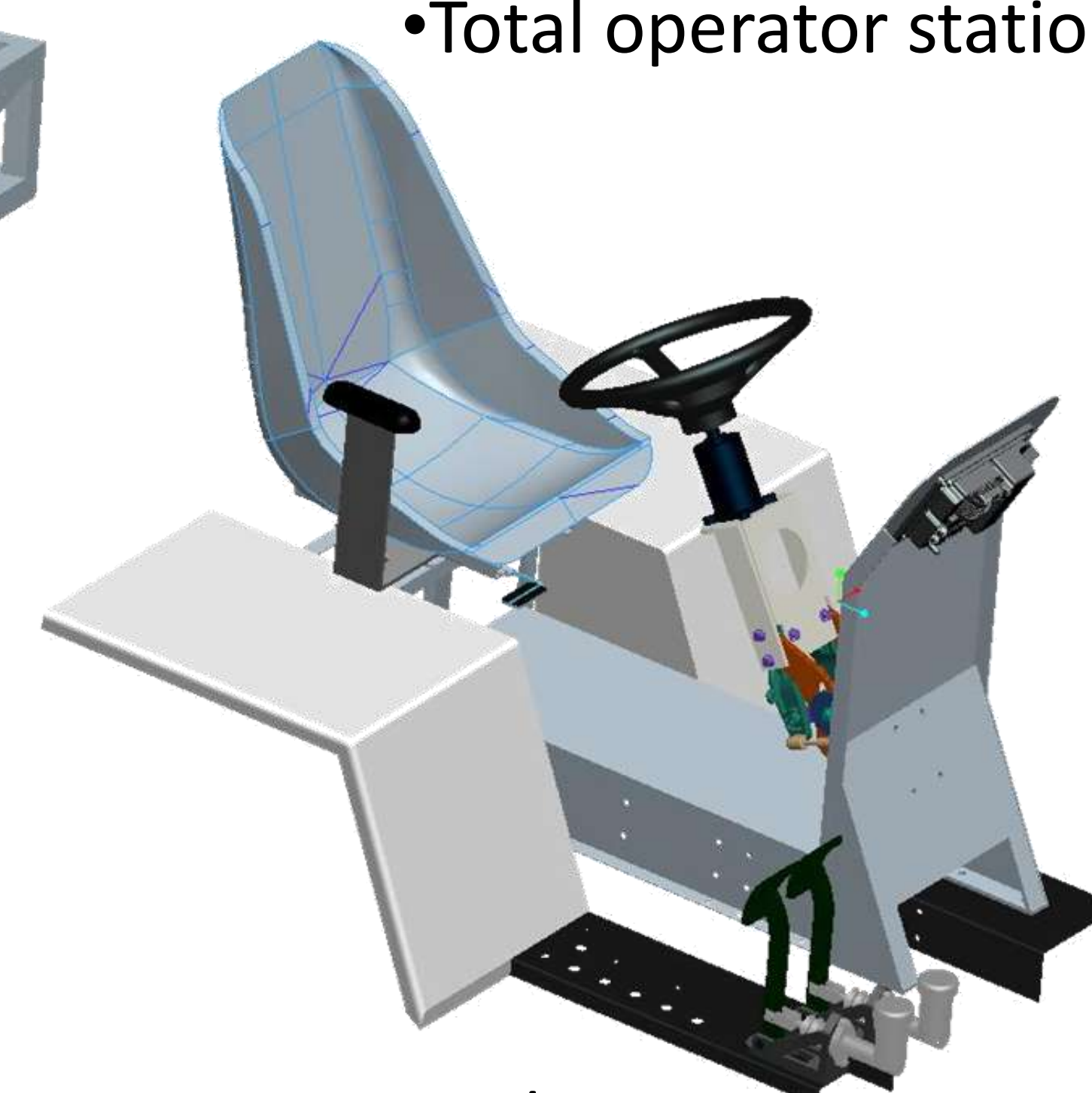


Objectives

- Easily accessible tractor operator's position
- Adjustable to a variety of operators
- Functional brakes that are efficient
- Total operator station to weigh less than 120 lbs

Implementation

- Armrest throttle control
- Sliding cushion seat and adjustable steering column provides comfortable positions for all operators
- A hydraulic steering system implemented in order to minimize the steering effort of the operator
- Operator station isolates the operator from moving components
- Total operator station weight of 126 lbs



Electronics

Objectives

- Construct a functioning electronic safety system which includes ignition components, seat safety switch, and throttle control
- A functioning data acquisition system using an IQAN display for operator use and interaction

Implementation

- Failsafe wiring system for complete control of the tractor
- Available IQAN system to record vital tractor parameters
- Stand-alone designs for independent operation of systems

