

INTRODUCTION

Sekisui Voltek reached out to Trine University in 2019 to design a test machine for a new foam product and made progress until the global pandemic closed Trine's campus. In 2021, a new team was assigned to this project as a continuation of last year's work. This new team had a potential solution for the foam splitting machine from the previous year that would split the foam in half, thus eliminating the need for personal to manually split the foam, see Figure 1. The current team continued the process by evaluating several design changes proposed by the sponsor leading to one optimized solution. The new solution is a machine composed of a frame, one rack of rollers, electric motor drive, and a hot wire to initiate the foam splitting function. This new machine also has a safety shroud cover, control panel, and implements a pinch point safety feature. The Foam Splitting Machine will help solve the problem for the team and Sekisui Voltek.

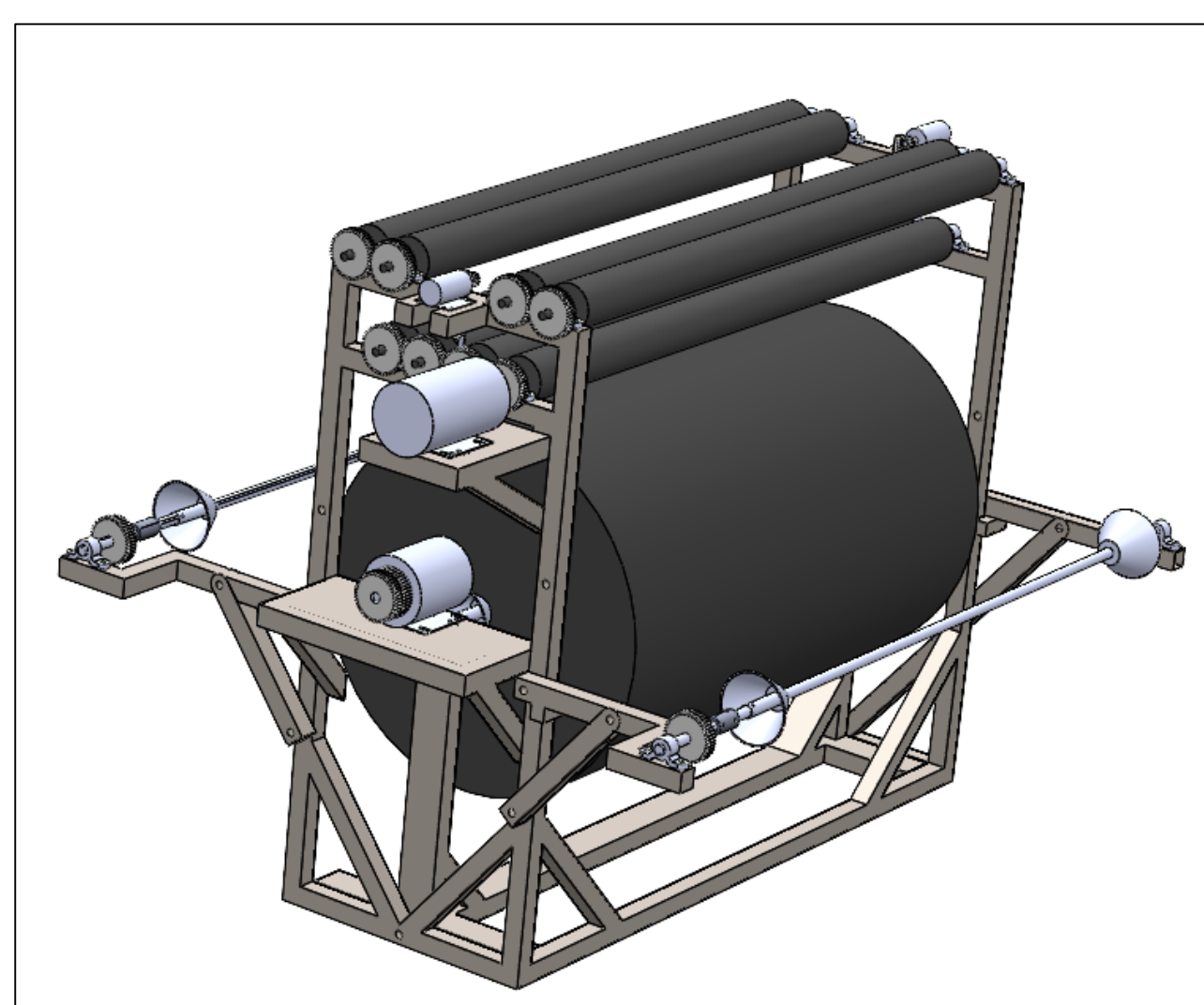


Figure 1: Original Design

CUSTOMER NEEDS

- Split the Foam
- Accessible
- Safety
- Durable
- Adjustable
- Variable Speeds

SPECIFICATIONS

- Emergency buttons
- Loading and unloading with two people
- Can move with 8 wheels attached
- Steel Design
- Rollers will finish the split
- Split the foam in under 5 minutes
- 3 roller adjustments for thickness of foam
- Width adjustable from the arms being upright
- Parts are covered that can hurt user

DESIGN CHANGES

Changes were made from the initial design of the project. These changes include a single row of rollers added safety features, and chain drive, see Figures 2-4. The hot wire will be manually operated eliminating one motor. Two e-stop switches are provided on both ends of the machine.

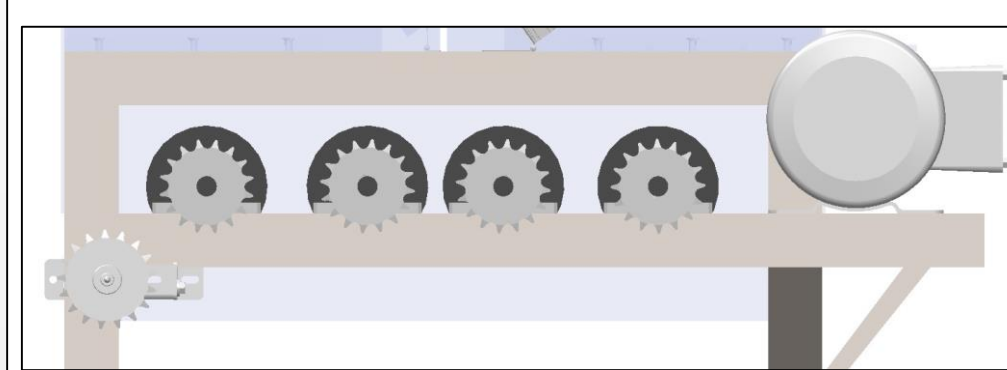


Figure 2: Four Rollers w/chain drive

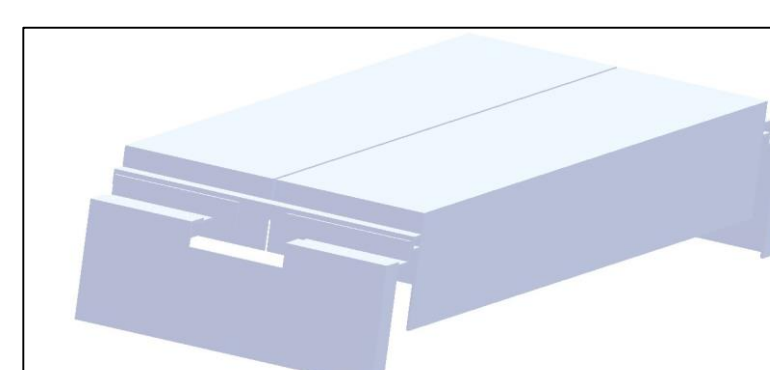


Figure 4: Safety Shroud (Closed)

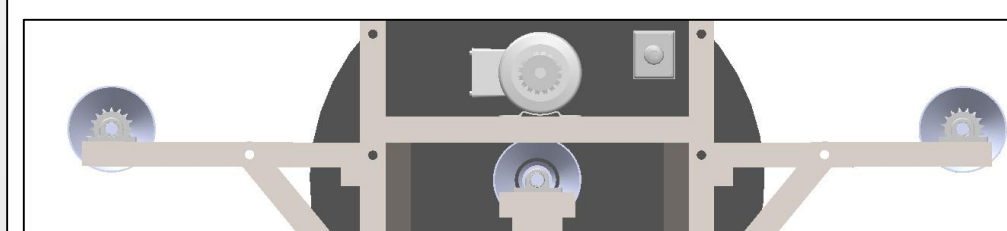


Figure 3: Spool chain drive

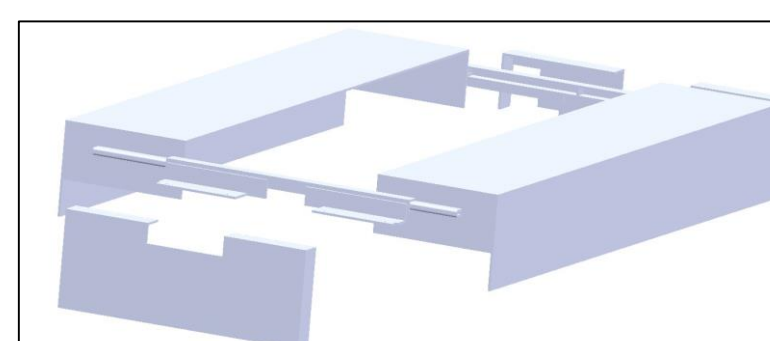


Figure 5: Safety Shroud (Opened)

SYSTEM-LEVEL DESIGN

The Foam Splitting Machine is comprised of four individual systems that enable functioning. The four functional systems include the power (Figure 6), alignment (Figure 7), receiving (Figure 8), and cutting (Figure 9). Each system was analyzed to give the machine the ability to split the foam effectively and efficiently.

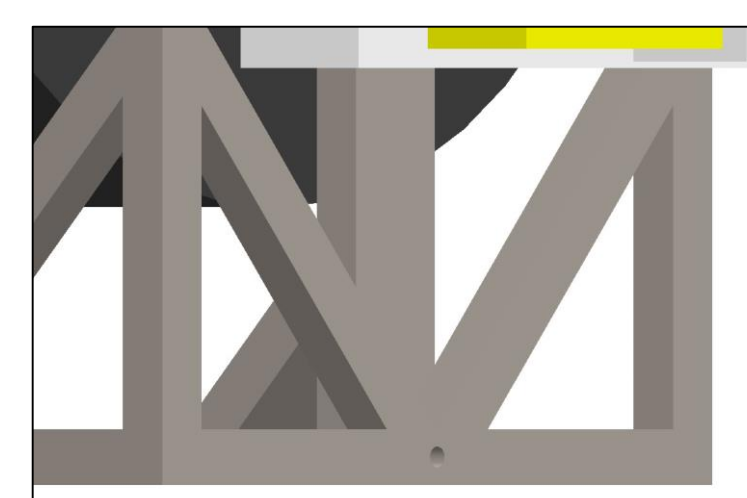


Figure 7: Lower Pin Alignment

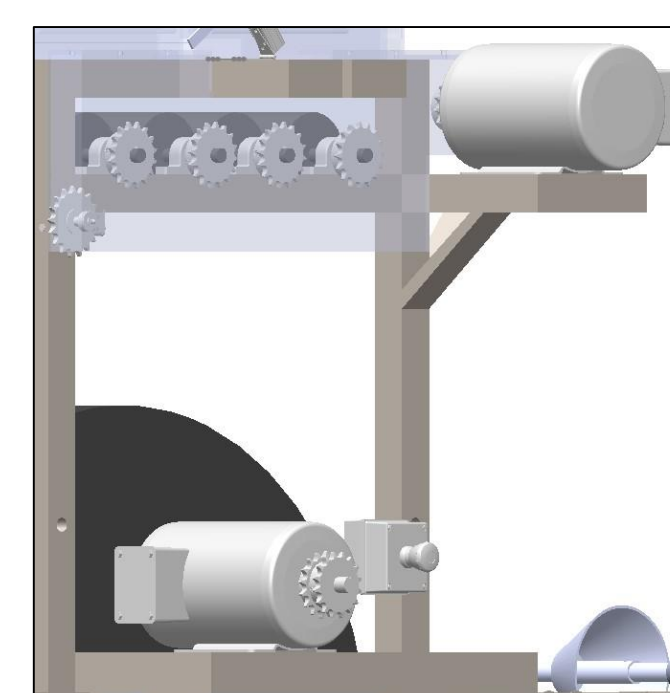


Figure 6: AC Motors

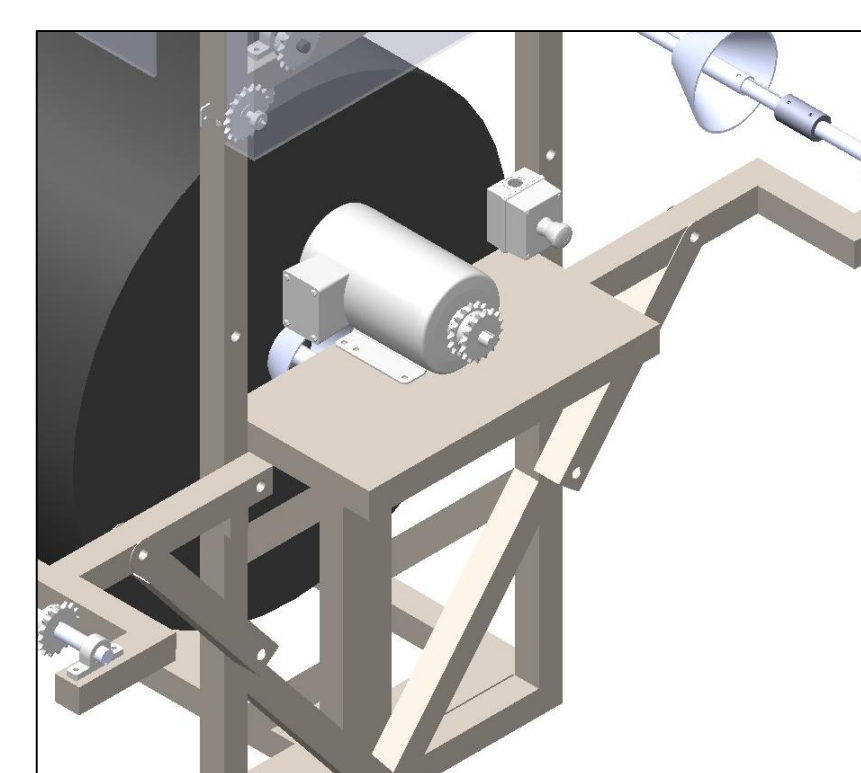


Figure 8: Receiving Arms

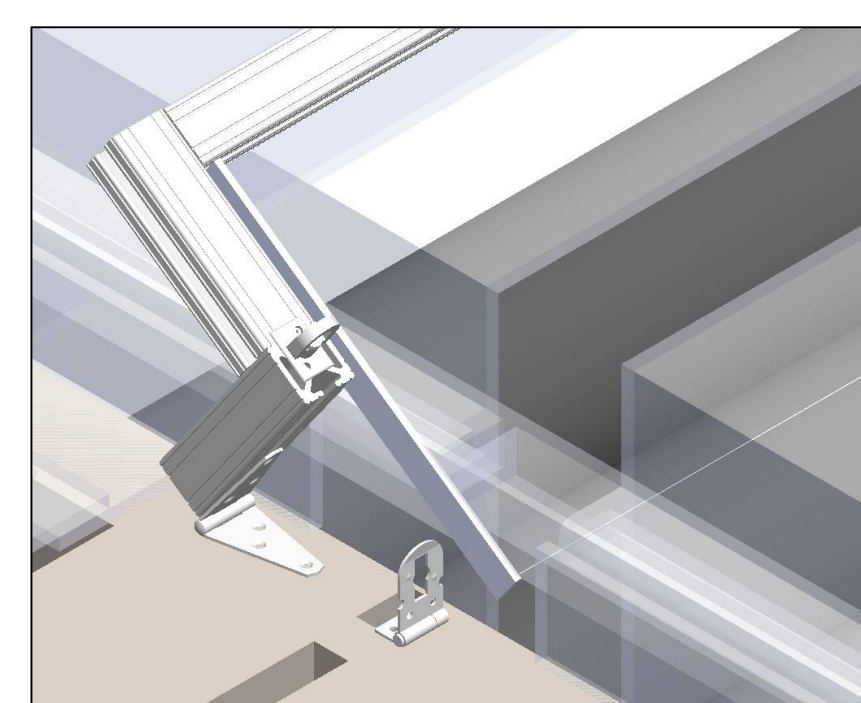


Figure 9: Moveable Hotwire

DESIGN HOQ

The team created a house of quality (HOQ) to evaluate all of the design needs and specifications and also to address any features that might affect each other in a positive or negative way. The three tables show here, Tables 1a-c, provide the teams assessment of the design needs and specifications and the relationships of each.

(a): Roof

Specifications	Thickness of Foam	Different Materials of Foam	Kill Switch	Force Meter Sensor	The foam can be loaded and unloaded	Different Foams can fit within the rollers
Different Foams can fit within the rollers						/
The foam can be loaded and unloaded					/	*
Force Meter Sensor				/		*
Kill Switch			/			
Different Materials of Foam		/				***
Thickness of Foam	/	*		*		*

(b): Needs

	Rank
OSHA Safe	5
Tension Control	5
Control Panel	3
Parallel Rollers	4
Foldable and portable	2
IMPORTANCE	Rank: 1-5

(c): Specs

Specifications	Thickness of Foam	Different Materials of Foam	Kill Switch	Force Meter Sensor	The foam can be loaded and unloaded	Different Foams can fit within the rollers
0	0	5	0	2	0	
5	5	0	5	0	3	
0	5	5	5	5	0	
4	3	0	5	0	0	
0	0	0	0	3	0	
	41	50	40	60	31	15

TEST RESULTS

The team ran Finite Element Analysis (FEA) on the final design of the foam holder frame. Shown in Figure 10 is an FEA test. Applied is a 4,000-pound force achieving a factor of safety of just over 1.

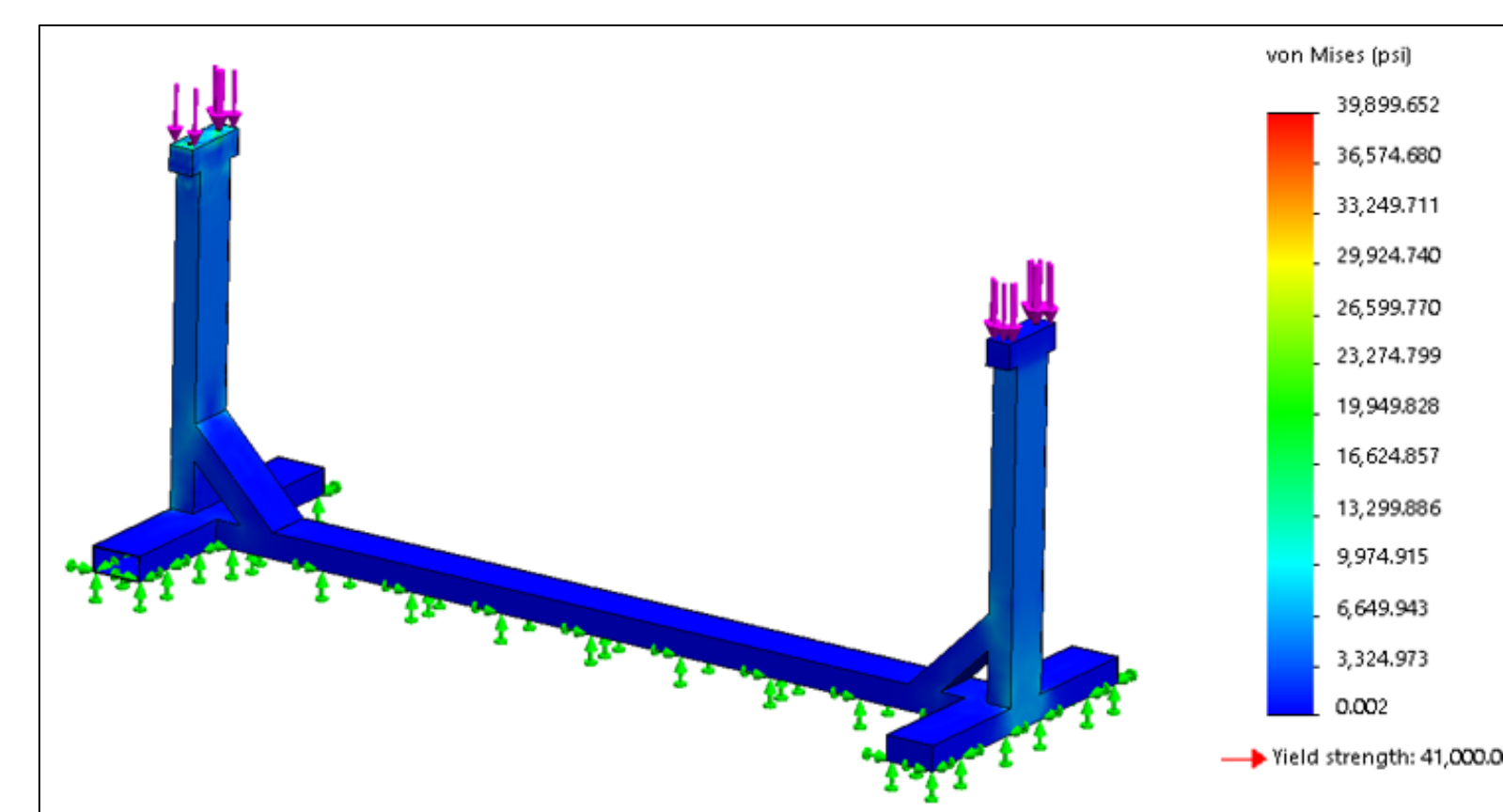


Figure 10: Applied Force

FINAL DESIGN

The final design is provided here in Figures 11 and 12. This incorporates the new 4 roller feed system, hot wire, safety shroud and e-stop switches. The team is planning to test the design during the last week of classes.

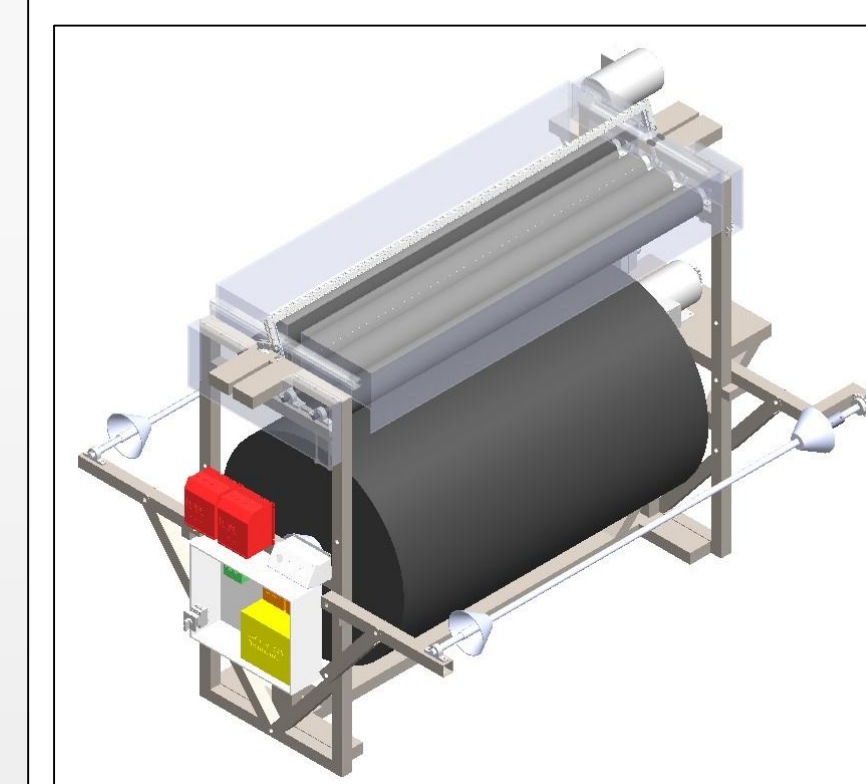


Figure 11: Final Design (Front)

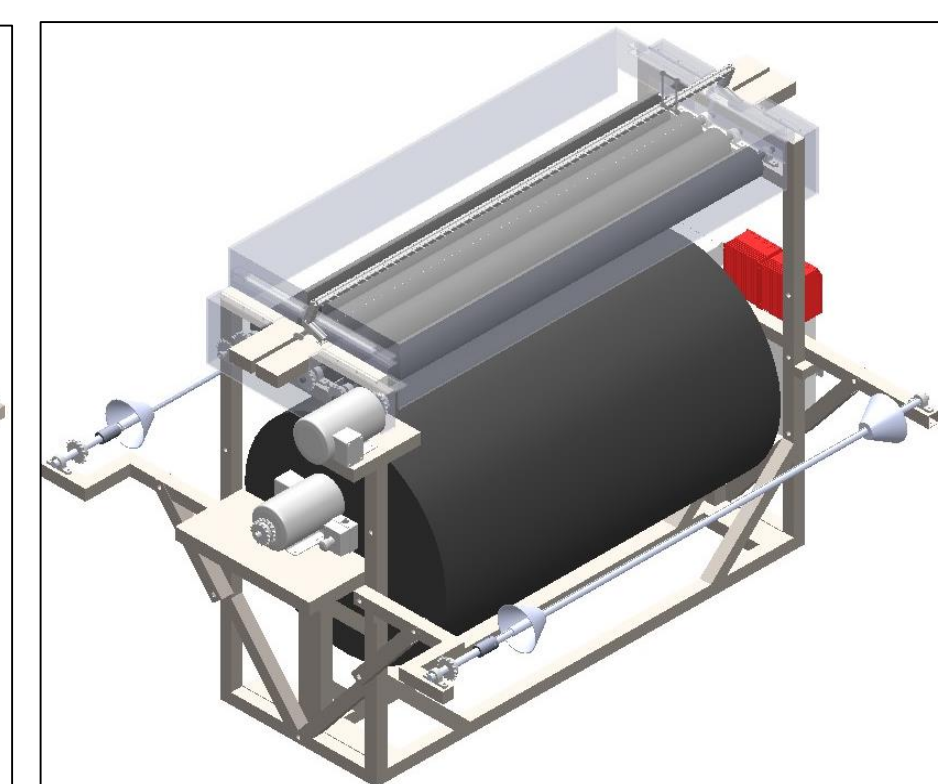


Figure 12: Final Design (Back)

CONCLUSION

The team was able to work not only with each other but with the help of outside resources to create a product that will satisfy the needs and wants of Sekisui Voltek. This was done by the team's ability to learn and evolve over the term to changing conditions and designs to ultimately work towards the goal of producing a more efficient product than the current system Sekisui Voltek currently has.

LESSONS LEARNED

- The team learned how to communicate with an outside entity to effectively complete the project.
- The team learned how to adapt to changing processes and designs throughout the year.
- The team learned how to balance schoolwork, jobs, and senior design while effectively producing for the sponsor and Innovation One.

ACKNOWLEDGMENTS

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