TEXAS STATE®
INGRAM SCHOOL OF ENGINEERING

Group M2.02 – Athena Tooling Team

Spring 2024

Benicia Cooper, Tracy Hall, Samuel Alvarez, Brandon Noria
Bill Johnson - Sponsor

ATHENA MANUFACTURING

Objective

- Athena Manufacturing offers precision machining, fabrication, and mechanical assembly services across diverse product sectors and industries. Within its repertoire, Athena frequently deals with intricate welded tubular frames, which pose challenges for both work holding and employee safety during product realization, particularly in the final assembly stage.

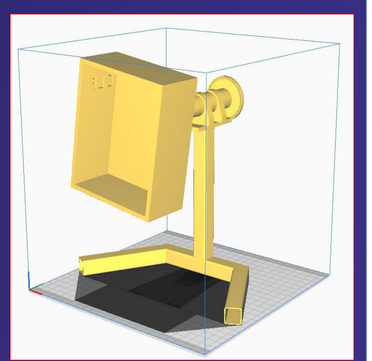
Stiffness Design

- We focused on rigidity for our tooling frame's structural strength, using AISI 1040 Steel for resilience against deformation and reducing bending under external forces. This method involves precise material selection, dimensions, and setups, aiming to optimize efficiency and safety during assembly at Athena's workplace.

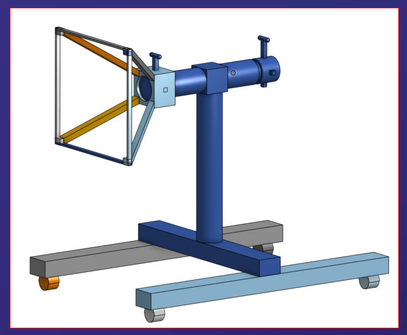
Linear Elasticity Properties	mean	range
bulk modulus	142 GPa (at 20 °C)	(140 to 165) GPa
Poisson ratio	0.29 (at 20 °C)	(0.29 to 0.3)
shear modulus	80 GPa (at 20 °C)	(80 to 82) GPa
Young modulus	203 GPa (at 20 °C)	(200 to 210) GPa

Prototyping

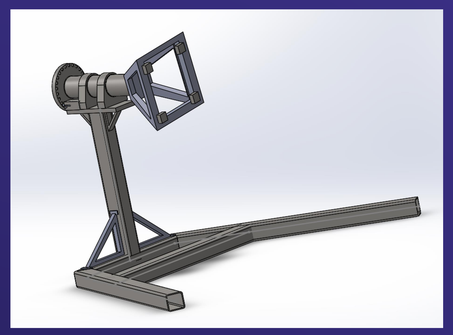
- To ensure the functionality of our tooling system, we plan to 3D print both a scaled-down model (1:5) of our design and a full-scale model (1:1) of the spinning mechanism. Printing in sections will minimize the need for support materials.
- This approach allows us to assess any necessary physical adjustments before proceeding with the fabrication of the steel work frame.



Chamber Lower Frame (CLF) Tooling System

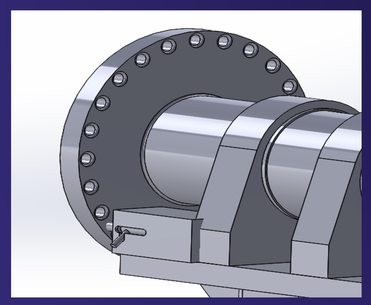


CLF Assembly Tool: Revision A

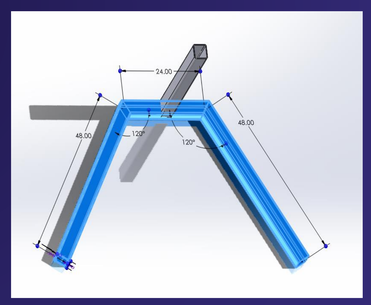


CLF Assembly Tooling System: Revision B

We've enhanced our initial design, moving from revision A to revision B, by introducing a single-sided attachment to focus on one CLF at a time. This change enables us to employ a rotational lock-pin mechanism (Figure 1) on the opposite end, enhancing rigidity and ensuring the workpiece remains stationary while the operator is engaged. Additionally, we've angled the legs outward (Figure 2) for increased stability, extending them beyond the point of force application on the workpiece to prevent wobbling or tipping over the tooling station.



Lock-Pin Mech. Fig. 1

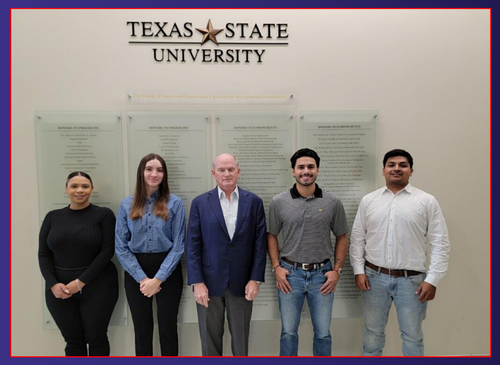


Frame Legs Fig. 2

Conclusions & Recommendations

As we wrap up the semester, we've developed a secure and adaptable Universal Stand for managing workpieces. This stand enables vertical movement and horizontal rotation, swiftly adjusting workpiece orientation to improve product flow and quality in Athena's lean and ever-evolving environment. With our design, we've laid the foundation for future teams to smoothly carry on our work, leaving room for potential modifications and enhancements to further refine this tooling system. Our recommendation to the next team would be to incorporate a spring lock pin to enhance this system further on.

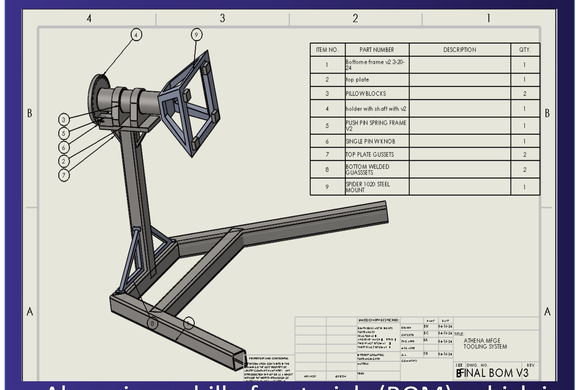
Team Members



Athena Tooling Team

Team ~ *Benicia Cooper, Tracy Hall, Samuel Alvarez, Brandon Noria.*
Sponsor ~ *Bill Johnson.*
Instructor ~ James Davidson.

Bill of Materials



- Above is our bill of materials (BOM), which is a detailed list of all the parts, components, and materials needed to make a product. It includes information like part numbers, descriptions, quantities, and sometimes suppliers. This is crucial for manufacturing, procurement, and quality control processes, providing a structured breakdown of what's required to build our product.