# 2019 NAU SAE Micro Aero - Flapjacks Team #329

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# Project Description and Sponsorship

SAE Micro Class as part of the Aero design series of SAE collegiate competitions

Students must

- Utilize design, analytical, and manufacturing skills
- Fit within box dimensions 12.125 x 13.875 x 3.625 inches
- Assemble within 3 minutes or less
- Create a high payload fraction.

Sponsors

- Northern Arizona University
- Quality Vans & Specialty Vehicles
- Society of Automotive Engineers
- Coconino High School Engineering Group

# Customer Requirements

- Fly
- Land
- Fly Multiple Times
- Compact
- Transportable
- Durable
- Easily Repairable
- Battery Powered
- Safe
- Lightweight
- Easy to Assemble
- Radio Controlled

# Unique Design Characteristics

- Modular interlocking fuselage
- Tail mounting bracketry
- Wing dowel inserts
- Payload carrying wing rib

# Fuselage and Tail Bracket

- Holds position of tail shaft in x, y, and z direction
- Holes for quick installation of tail shaft and hardware
- 3D printed PLA material

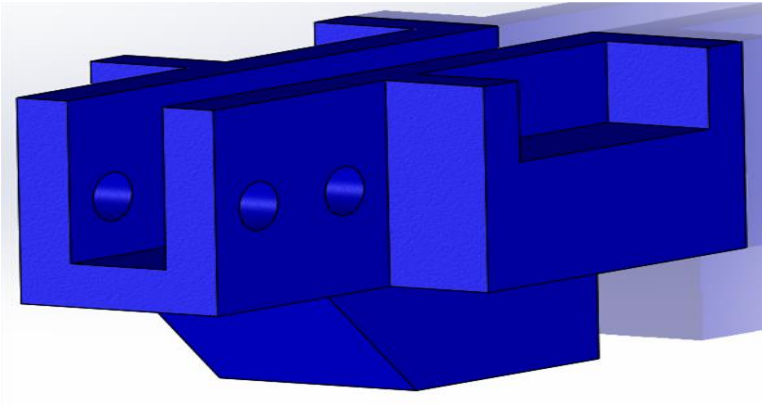


Figure 1: Fuselage mounting bracket

# Wing Dowels and Payload Rib

- Combination of two pieces solves 2 problems
  - Holds wings in place
  - Mounts payload
- Payload spacer material is ABS
- Wing dowel is machined 6061 aluminum

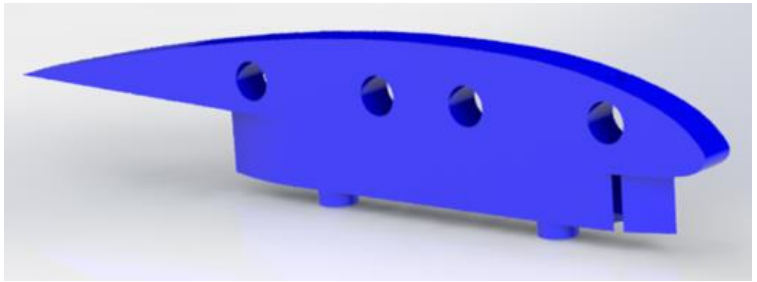


Figure 2: Wing and payload attachment rib

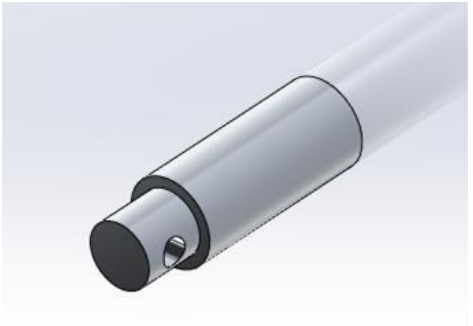


Figure 3: Wing dowel attachment

# Design Challenges

- Size Constraint
- Payload Attachment
- Wing to Fuselage attachment
- Landing Gear
- Servo Sizing
- Aerodynamics

# Size Constraint

- Box dimensions
  - 12.125 x 13.875 x 3.625 inches
- Assembly and disassembly
  - 3 minute time limit
- Repairability

# Aerodynamics

- Clark Y Airfoil 11.7% Max Camber
- Lift and Drag Generated
- Chord and Aspect Ratio Changes
- Aileron Sizing

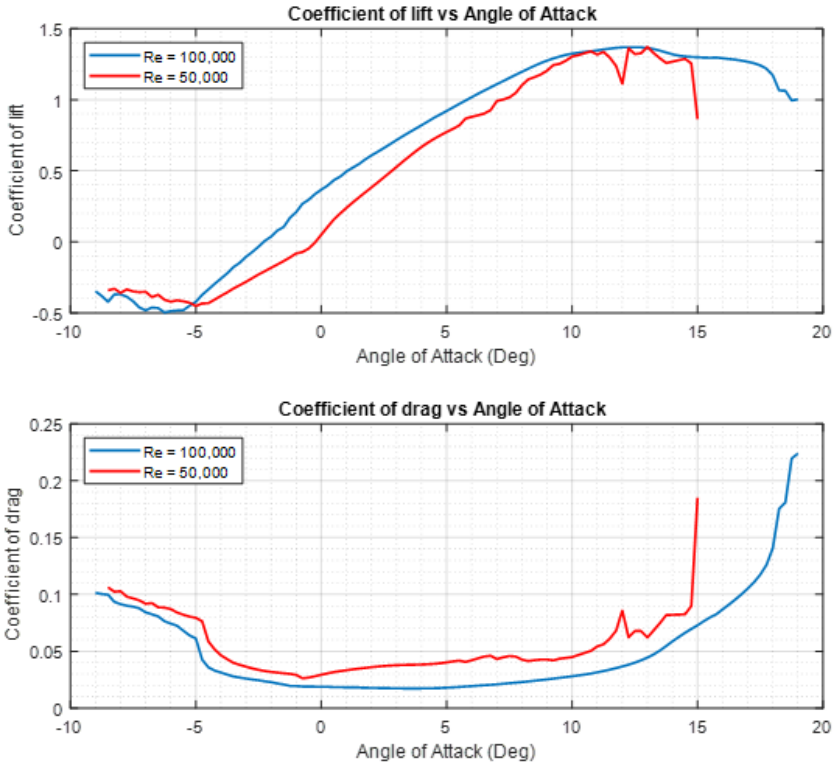
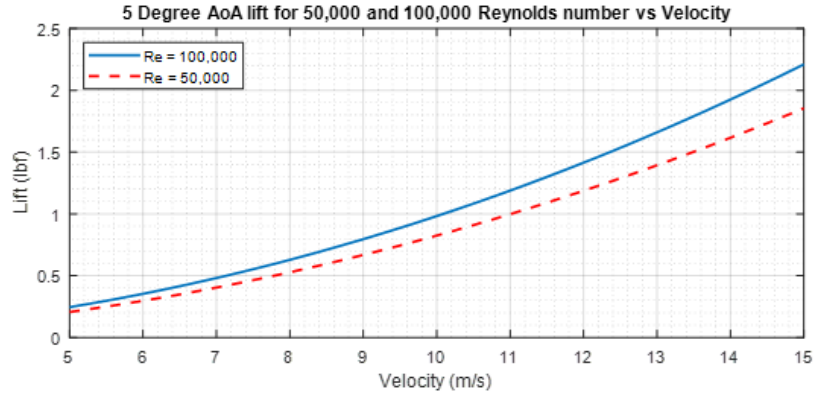



Figure 4: Airfoil characteristics

# Lift and Drag at Cruise

- Initial calculations
- Lift and drag at 13 m/s (29 mph)
  - 1.4 lbs of lift
  - 0.073 lbs of drag



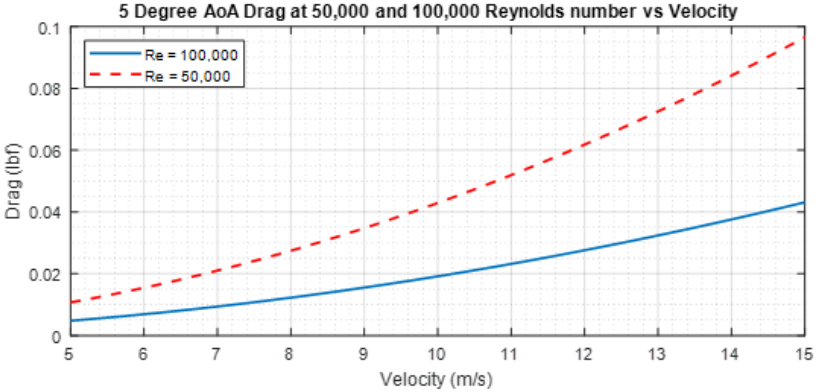




Figure 5: Lift and drag

# Payload and Wing to Fuselage Attachments

- Size and weight
- Compact and quick assembly
- Safety

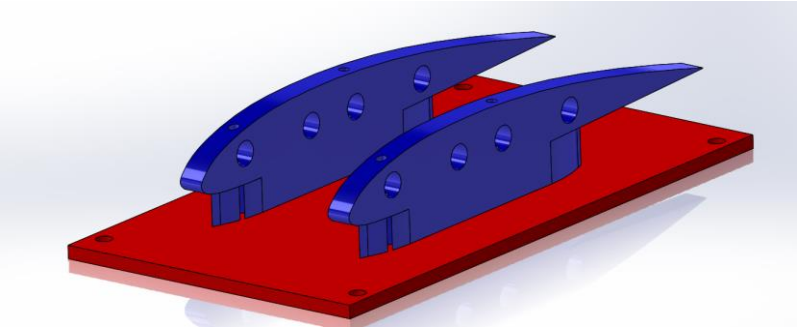


Figure 6: Wing to fuselage attachment

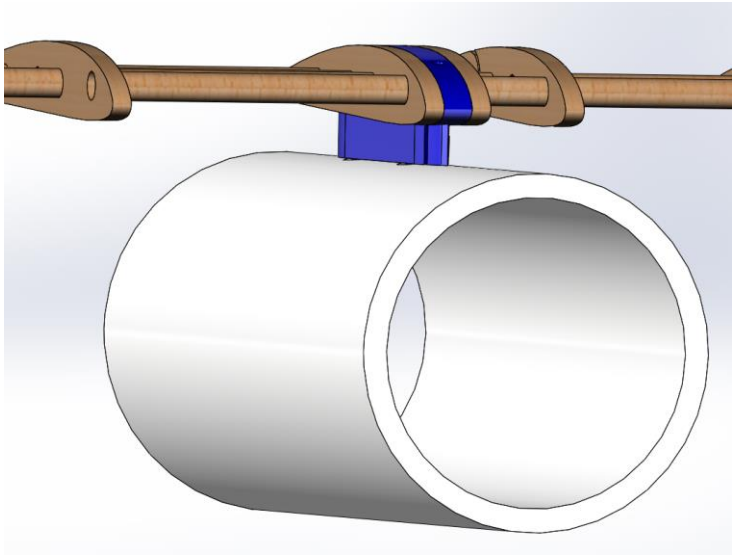


Figure 7: Payload attachment

# Landing Gear and Servo Sizing

- Lightweight requirement
- Quickly Attachable
- Structurally sound landing gear
- Hard to find servos small enough
  - 0.5 x 1 x 1 inches
  - Less than 10g

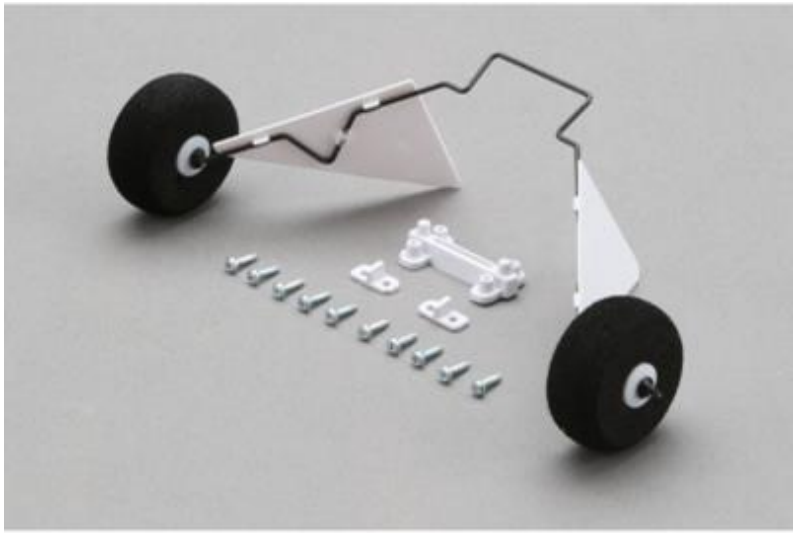


Figure 8: Landing gear

# Manufacturing Techniques

- Laser cutting for tail, wings, and fuselage
- Modular design for ease of replacement

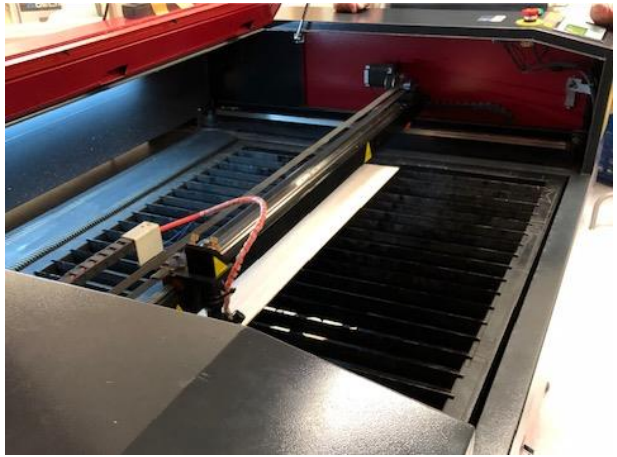


Figure 9: Laser cutter

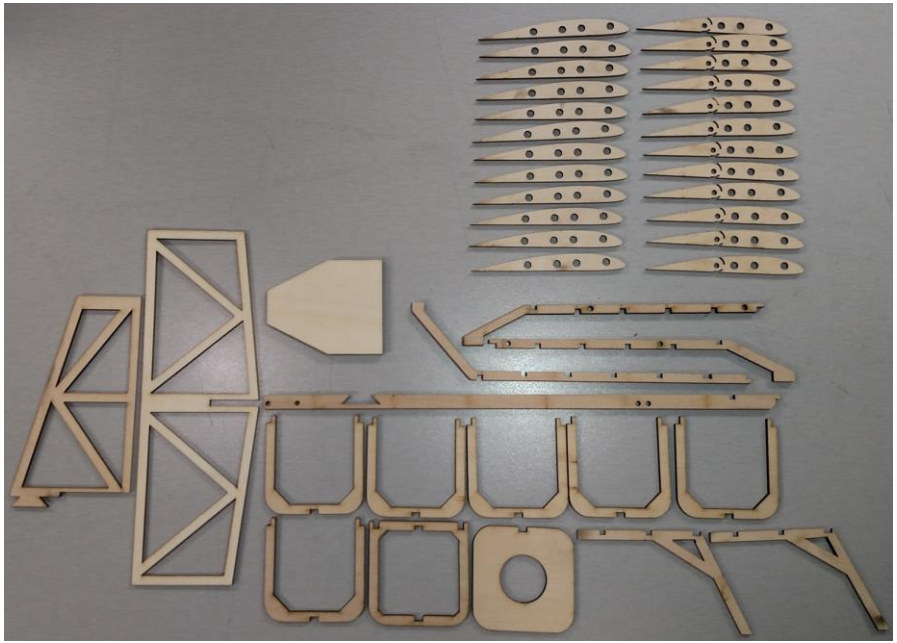


Figure 10: Laser cut parts

# Aluminum Inserts

- Wing Stiffness
- Self-Centering

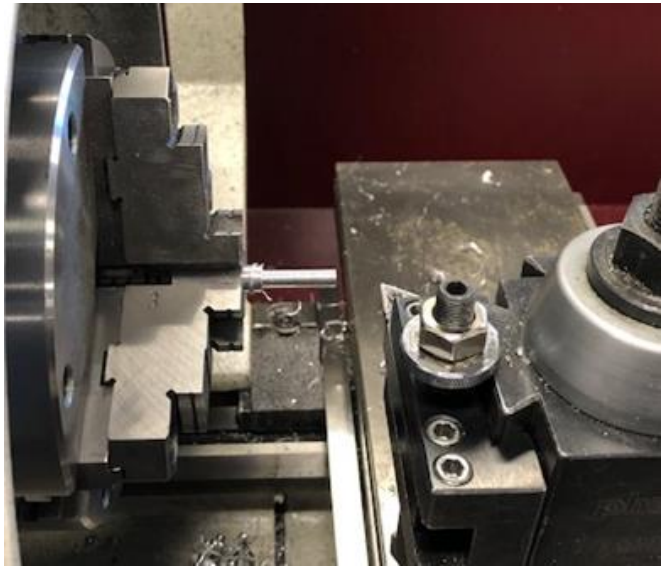


Figure 11: Turning on the lathe

Figure 12: Size Comparison

# Conclusion

- Unique Features
  - Modular
  - Mounting Brackets
  - Payload/Wing Rib
  - Wing Dowel Inserts
- Design Challenges
  - Size
  - Aerodynamics
  - Payload Attachment
- Manufacturing Techniques
  - Turning
  - Laser Cutting
  - Jigging
  - Milling
- Future Work
  - Design and build final iteration
  - Compete

# Acknowledgements

*We would like to specially thank*

- **Northern Arizona University**
  - Funding project and making this project possible
- **David Trevas**
  - Senior design mentor
- **John Tester**
  - Being our client and providing necessary knowledge
- **Craig Howdeshell (CHS Engineering Group)**
  - Use of the laser cutter at CHS
- **Quality Vans and Specialty Vehicles**
  - Providing travel funds

# Questions?