Wind Tunnel

AUTHORS

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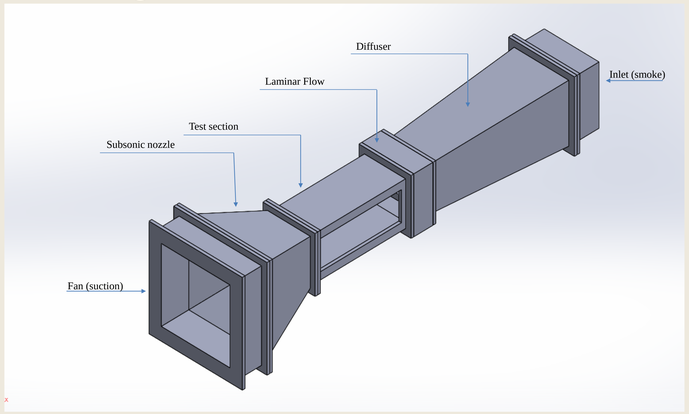
CAD Design



Introduction

What is a Wind Tunnel ?

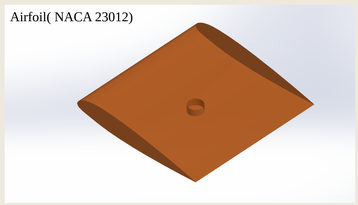
Wind tunnels are tube-shaped facilities that allow engineers to move air over a vehicle as if it were flying. They help researchers to learn more about how an aircraft will fly.

Material & Components

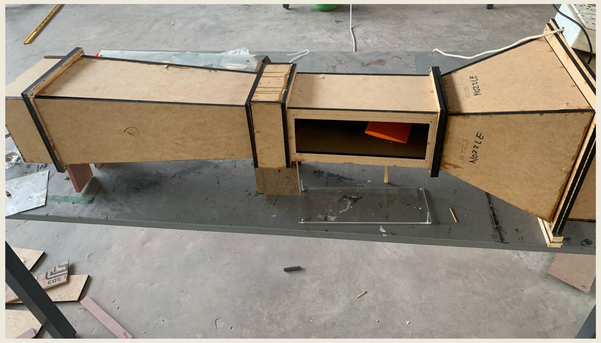
- 10mm MDF
- Acrylic sheet (5mm)
- Arduino
- Load Cell
- Onyx 6 inch exhaust Fan
- Straws
- Airfoil

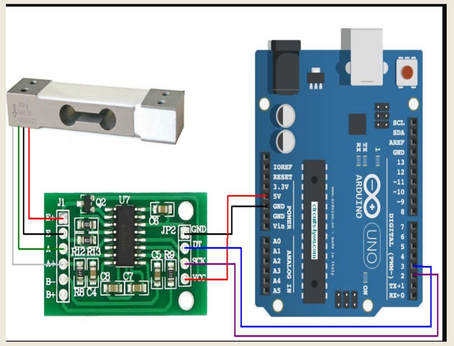
Testing Component

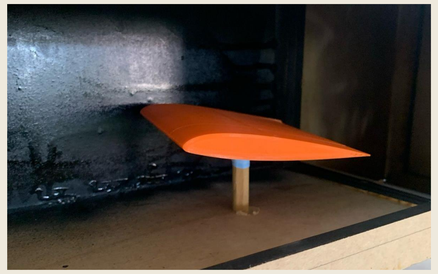
Airfoil(NACA 23012)



Model Photos







Possible Uncertainties

- Flow Characteristics
- Model Instrumentation and measurement
- Scaling and Extrapolation

Results (graphs based on load cell readings)


```
2.00,0.71
2.13,0.69
2.27,0.67
2.40,0.66
2.53,0.64
2.67,0.63
2.80,0.61
2.93,0.60
3.07,0.59
3.20,0.58
3.33,0.57
3.47,0.56
3.60,0.55
3.73,0.54
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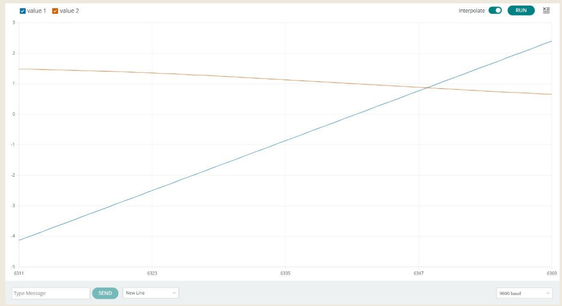
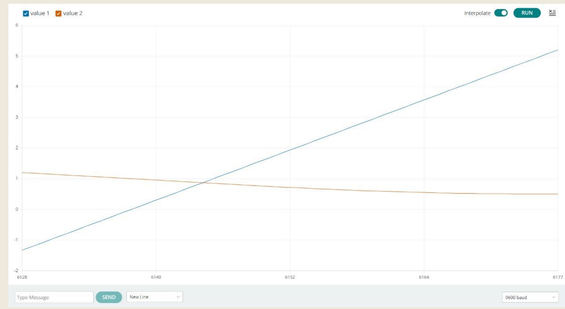
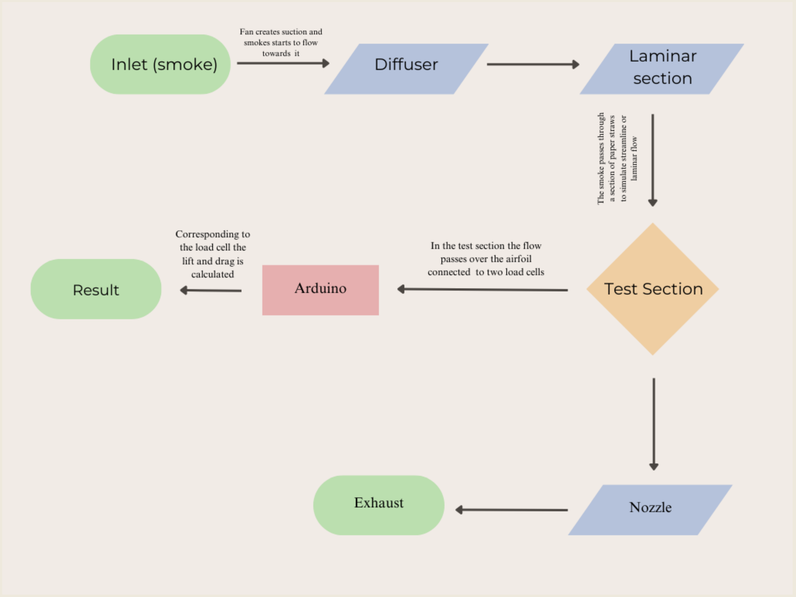




Schematic



Construction

1. Defined requirements, model flow, and finalize wind tunnel design.

2. Created CAD drawings, identified materials, and laser cut MDF parts.

3. Assembled MDF components using adhesives, ensuring proper alignment.

4. Secured assembled parts with screws, verify dimensional accuracy.

5. Installed test model, mount exhaust fan, and connect to power.

6. Calibrated instrumentation and integrated with mechanical model for data acquisition.

Learning Outcomes

- Understanding of the key design considerations for wind tunnels, such as test section dimensions, flow velocity range, and support structures
- Skill in creating detailed technical drawings using CAD software
- Proficiency in utilizing laser cutting or other manufacturing methods to precisely fabricate wind tunnel components
- Competence in assembling complex structures using adhesives, fasteners, and alignment techniques
- Capability to integrate mechanical, electrical, and instrumentation systems to create a functional wind tunnel
- Understanding of the principles and challenges in calibrating and integrating sensors, such as load cells, for accurate data acquisition
- Skill in documenting the design, construction, and testing processes for the wind tunnel
- Ability to identify and address potential challenges or uncertainties throughout the wind tunnel project
- Development of critical thinking skills to troubleshoot issues and optimize the wind tunnel's performance
- Capacity to work collaboratively in a team environment, coordinating the efforts of different team members

Areas of Improvement

1. Design Optimization:
   - Refine CFD modeling, explore alternative materials and manufacturing.

2. Precision Manufacturing:
   - Investigate advanced cutting techniques, utilize 3D printing.

3. Assembly and Integration:
   - Improve assembly procedures, automate integration of instrumentation.

4. Uncertainty Quantification:
   - Implement comprehensive uncertainty analysis, enhance calibration.

5. Operational Efficiency:
   - Optimize energy use and noise levels, streamline testing process.

6. Maintenance and Upgradability:
   - Design for easy servicing and future upgrades.