Collegiate Wind Competition 2017-2018

Mechanical Design

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Collegiate Wind Competition U.S. Department of Energy

Presentation Outline:

- Project Description
- Budget
- Design Requirements
- Design Subsystems
- Material Selection
- Design Process
- Manufacturing Process
- Final Design
- Testing Procedures
- Data Collection

Project Description

Collegiate Wind Competition (CWC)

- Event Sponsors:
  - U.S. Department of Energy (DOE)
  - National Renewable Energy Laboratory (NREL)
- Clients:
  - David Willy
  - Karin Wadsack
- Team Goal:
  - **Build & Test a Small Scale Wind Turbine.**

Budget

- **Build/Design :**
  - GORE: $3000

- **Traveling:**
  - PAY ‘N TAKE: $60.00
  - BIGFOOT BBQ: $150.00
  - ASNAU: $923.08

Table 1: Building Budget for Mechanical Team

Total	Expenses	Remaining
$1500	$756.82	$743.18
$3000	$1905.43	$1094.57

Design Requirements

- Turbine Size: 45cm x 45 cm x 45 cm.
- Operating Wind Speed = 2 - 20m/s ± 2m/s
- Cut-In Wind Speed = 2 m/s → 5 m/s
- Cut-Out Wind Speed = 20 ± 0.5m/s
- Power Generation > 10 WATTS @ 10 m/s
- Turbine Efficiency = 35% ± 5%

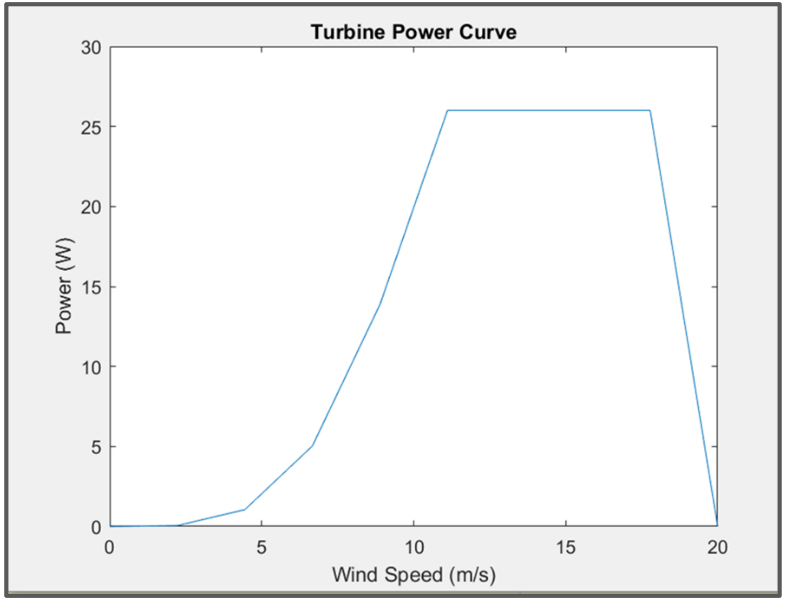

Figure 1: Turbine Power Curve

Design Subsystems

- Blade Design
  - Devon
- Hub Design
  - Spencer
- Shaft
  - Soud/Kory
- Braking System
  - Jacob
- Yawing Mechanism Design
  - Jacob
- Nacelle Design
  - Dakota
- Tower Design
  - Dakota
- Base-plate Design
  - Dakota

Material Selections

3D Print

- Blades
  - ULTEM 9085
- Active-Pitching Hub
  - ABS 3D Filament

Structural Metals

- Blade Roots
  - T304 Stainless Steel
- Tower
  - 4130 Steel
- Baseplate
  - A36 Steel

Lightweight Metals

- Nacelle
  - 6061-T6 Aluminum
- Yaw Fins
  - 6061-T6 Aluminum
- Shaft
  - 7075-T6 Aluminum

Braking System

- Disk: Zinc Coated Steel
- Pads: Rigid Molded Non-asbestos

Design Process

- CAD design and modeling
- Programming verification
- Prototyping
- Redesign and prototyping
- Final design and approval

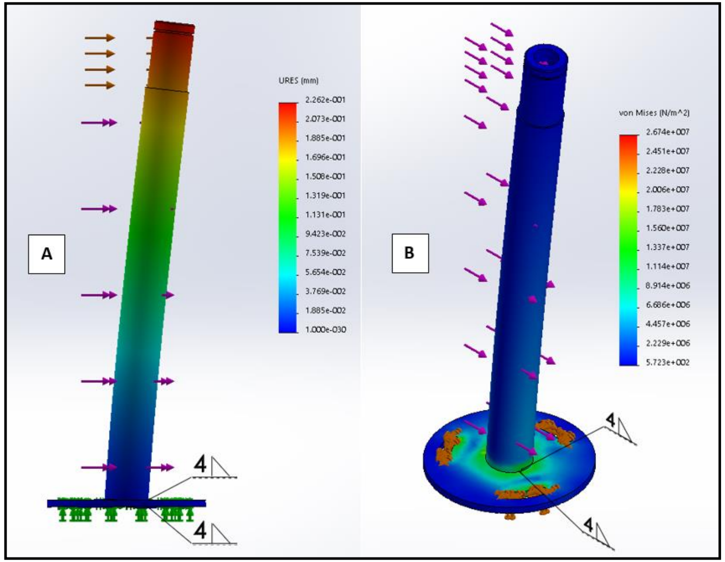

Figure 2: SOLIDWORKS FEA simulation

Manufacturing Process

Machines Used

- CNC Mill
- Manual Mill
- Lathe
- 3D Printer

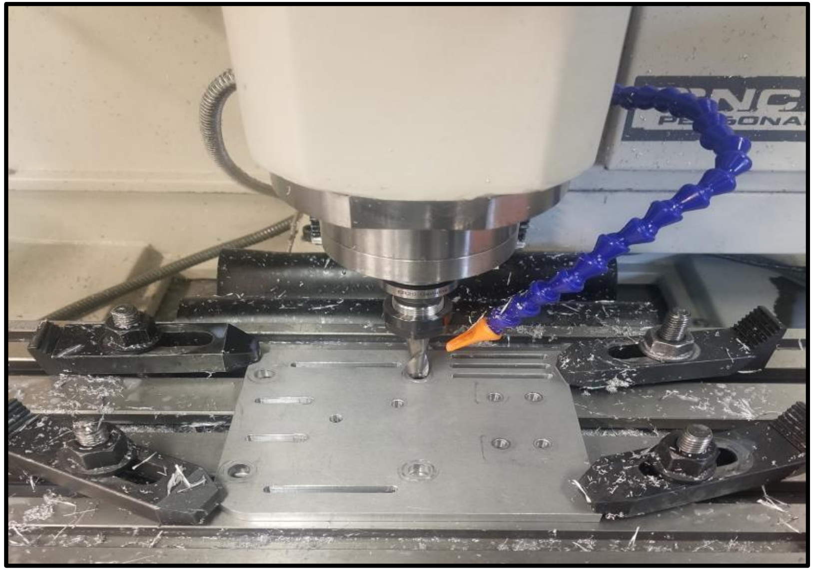

Figure 3: Top Nacelle on the CNC

Final Design

- Latching Solenoid Braking system
- Dual fin Passive yawing system
- Multi-layered Nacelle
- Direct Drive Shaft
- Active Pitching Hub

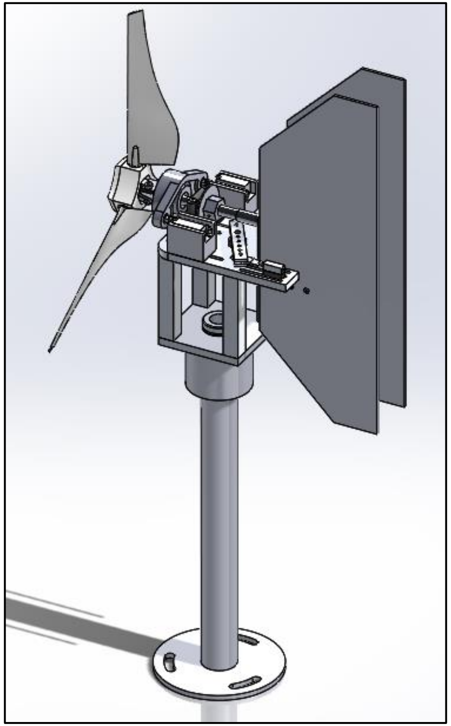

Figure 4: Final CAD Design

Data Collection

- Developed a LabVIEW data acquisition program
- Created for measuring wind tunnel wind speeds
- Used pre-created programs to produce functional program for our testing purposes

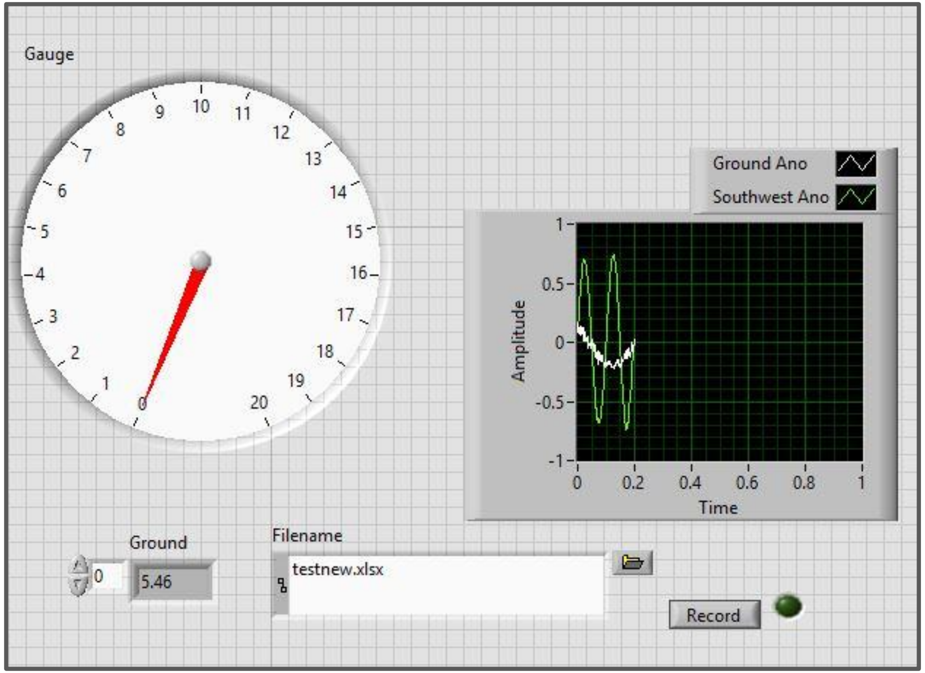

Figure 5: LabVIEW Wind Speed Program

Testing

- Procedure
  - Testing at an off campus wind tunnel provided by Southwest Windpower
  - Redesigned wind tunnel fixture
  - Redesigned anemometer mount for data acquisition
  - Testing single subsystems before testing the system as a whole
- Results
  - Blades start up at a wind speed of 5 m/s
  - Brakes can effectively stop the turbine from spinning up to a wind speed of 7 m/s

Questions?