WATurbine

F24 First General Meeting

Thursday, October 3rd , 2024

Agenda

- Icebreaker
- Introduction to WATurbine
  - Engineers Without Borders
  - The Team
  - Small Wind Turbines
  - The Competition
  - Team Progress
- Sub-Teams
  - Aerodynamics
  - Controls
  - Mechanical
  - Power
  - Structural

F24 Executive Team

Katherine Nguyen
Project Manager

Jun Woo Oh
Project Manager/Mechanical Lead

Steven Armstrong
Embedded Systems Director

Alan Hu
Aerodynamics Lead

Violet Hu
Aerodynamics Lead

Katherine Liu
Aerodynamics Lead

Xander Hayhoe
Controls Lead

Ben Liu
Power Lead

Evan Kwon
Mechanical Lead

Robert List
Mechanical Lead

Laasya Rajgopal
Structural Lead

Chantel LeClercq
Structural Lead

Icebreaker

PICK A SIDE

Project Managers

Katherine Nguyen
Project Manager

Jun Woo Oh
Project Manager
(On-Site F24)

Engineers Without Borders

Engineers Without Borders

est. 2000

"Our vision is to engineer an equitable and sustainable future for marginalized people and the planet.

Our mission is to create systemic change through community-driven collaboration. We mobilize the engineering community and leverage technological innovation to address urgent and important global challenges, both within Canada and beyond."

People

Ventures

Advocacy

engineers without borders
ingénieurs sans frontières
Canada

University of Waterloo Chapter

- 32 chapters of Engineers Without Borders across Canadian colleges and universities
- Carries EWB mission at the post-secondary level

- Sustainable engineering design competitions
- CAIF: Canada-Africa Innovation Fellowship
- XChange conferences

- Registered club & design team

Education

Fundraising

Communications

Podcasts

Design

OpenAir Carbon Capture

Small Wind

engineers without borders
ingénieurs sans frontières
Canada

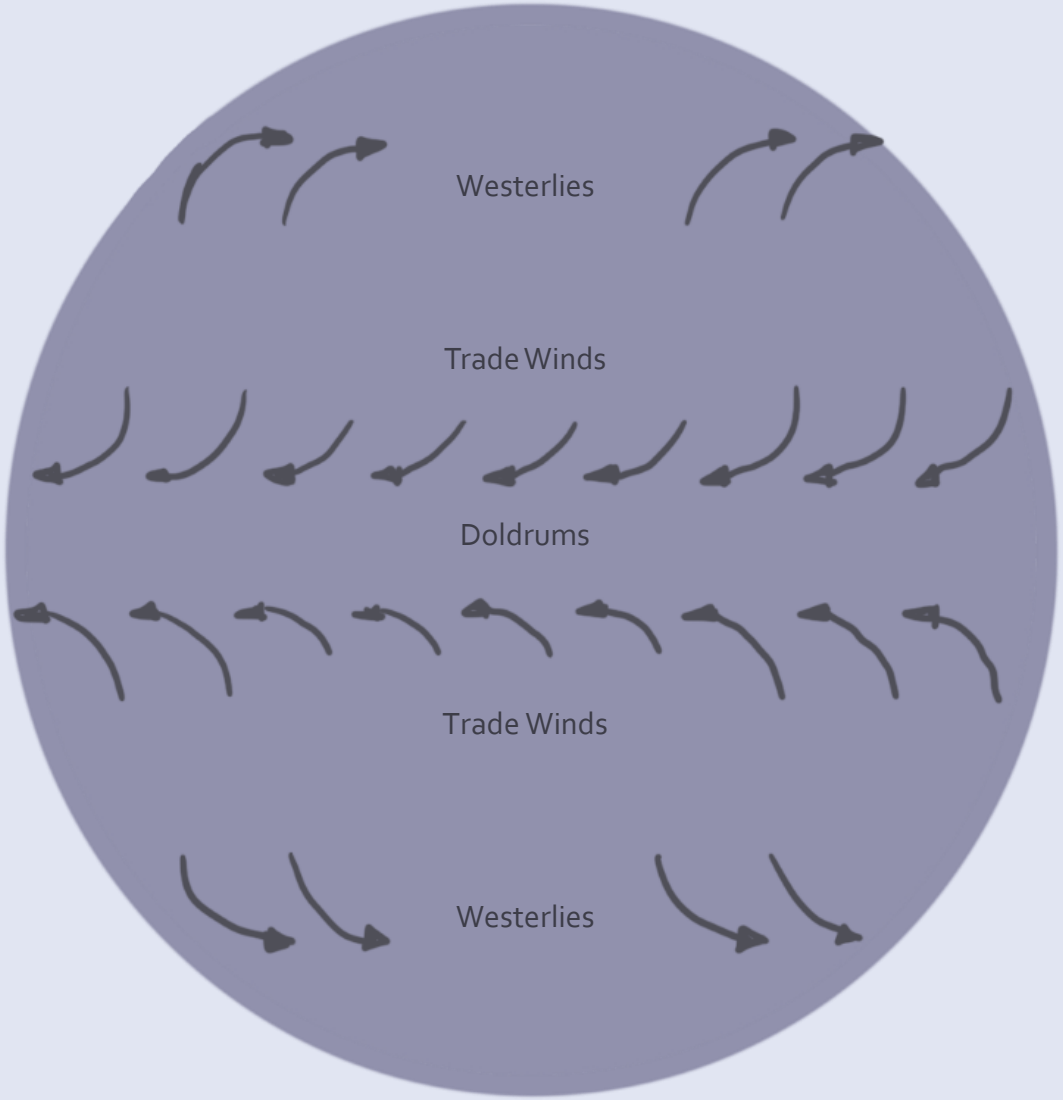
The Team

Core Values

- Our mission is to engineer a small wind turbine that demonstrates the best sustainability and efficiency for the International Small Wind Turbine Contest in summer 2025.
- Our vision is to push the boundaries of sustainability and accessibility within the renewable energy industry, while attracting more students to join Engineers Without Borders.
- Our team values innovation, passion for sustainable engineering, and inclusivity within our community. We strive to bring bright minds together to work on challenging problems in one of the world's most important industries! Respect and inclusion are at the core of our team.

Structure

- Westerlies: Team members!
  - Attend meetings
  - Participate in sub-team tasks
- Trades: Exceptional Team Members!
  - Completing multiple important tasks
  - Being mentored by team leads to become next Doldrums
- Doldrums: Team Leads!
  - Managing sub-teams or team as whole
  - Leading design of turbine



Communication Channels

- Engineers Without Borders
  - **Slack**
  - @uwewb
- WATurbine
  - **Discord**
  - **Notion**
  - @uwwaturbine
- Fill out the form in the QR code and find all communication access through #resources

Why join WATurbine?

Small/New Design Team

- Easier to have more 1:1 time with team leads and other members
- The work you do is immediately valued & recognized!
- Lots of opportunities to take initiative/ gain leadership roles
  - More opportunities to contribute to the research & development stages of a project
- Learn by doing!

Large/Established Design Team

- Higher complexity and size of projects (ie. small wind turbine vs. a car)
- More funding → Access to resources & tools
- Lots of well-designed onboarding/training already in place
  - CAD workshops
  - FEA workshops
  - PCB Design
  - Etc.
- Opportunities to network with more people

Onboarding

1

Fill out the recruitment form!

2

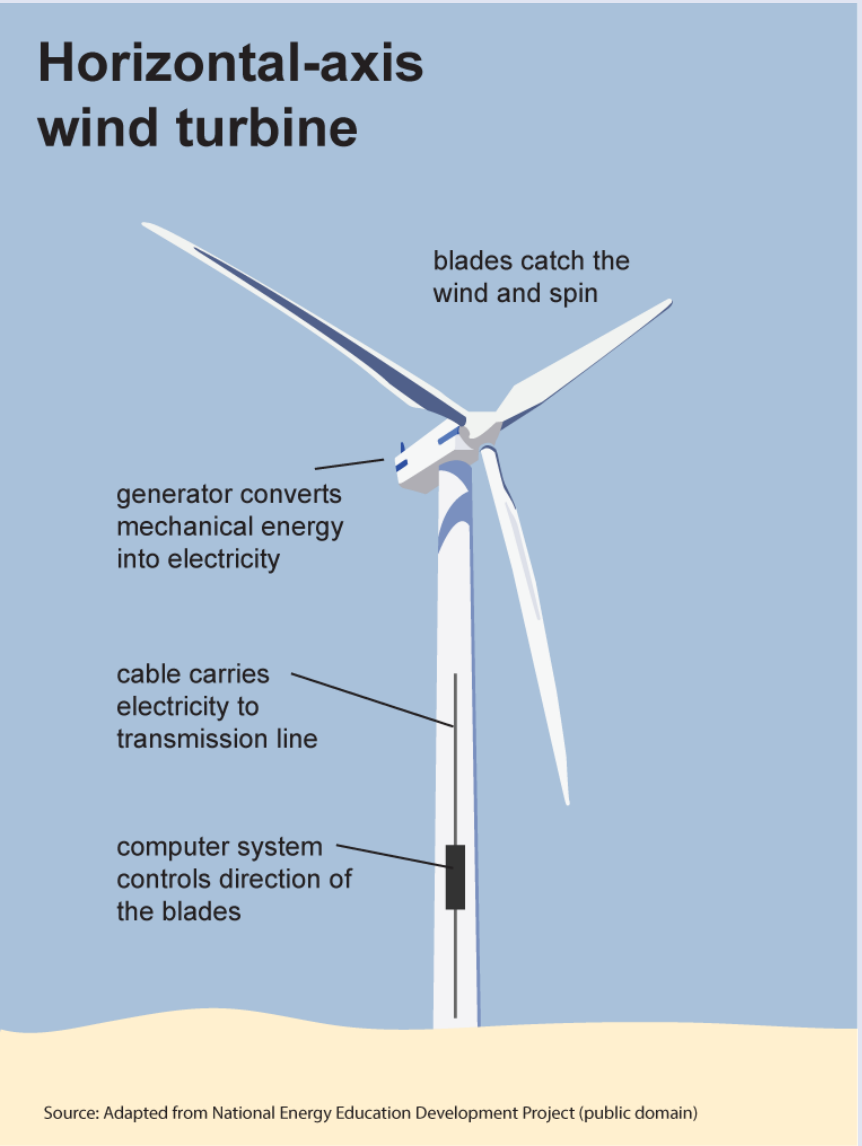
Join the Discord, Slack, and Notion!
All found under #resources of the Discord channel.

3

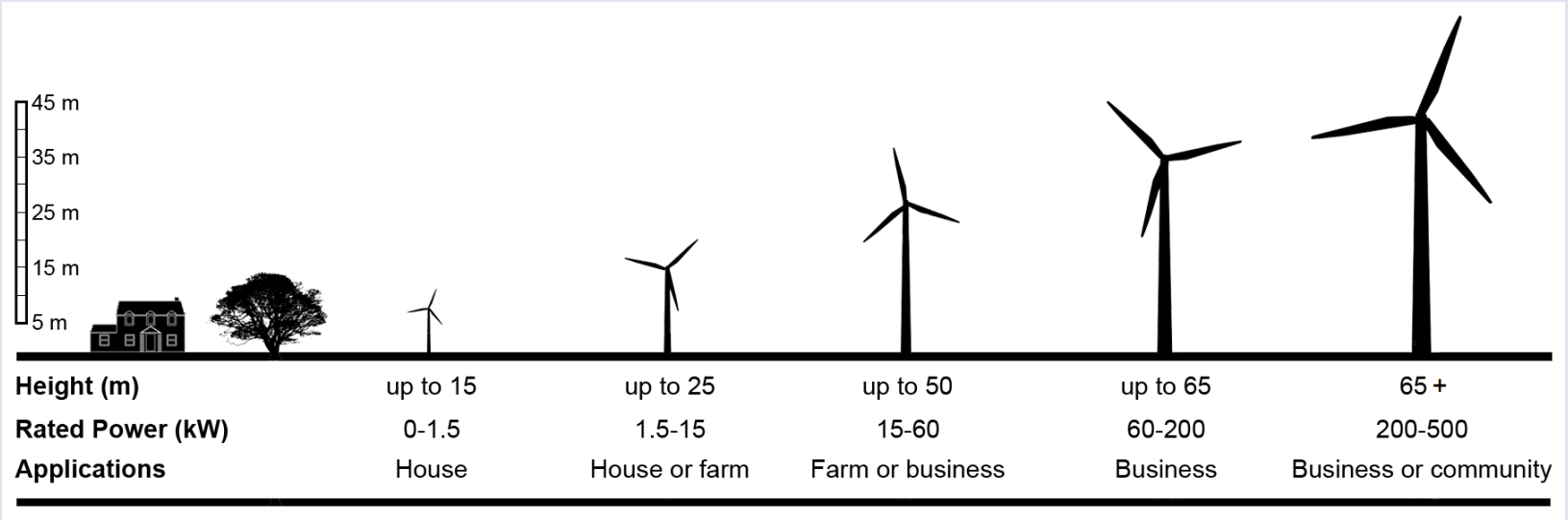
Start attending meetings!
Will be posted under each sub-team and in #meetings.

Small Wind Turbines

Wind Turbines



- One of the major forms of renewable energy
- Wind's kinetic energy → Electricity

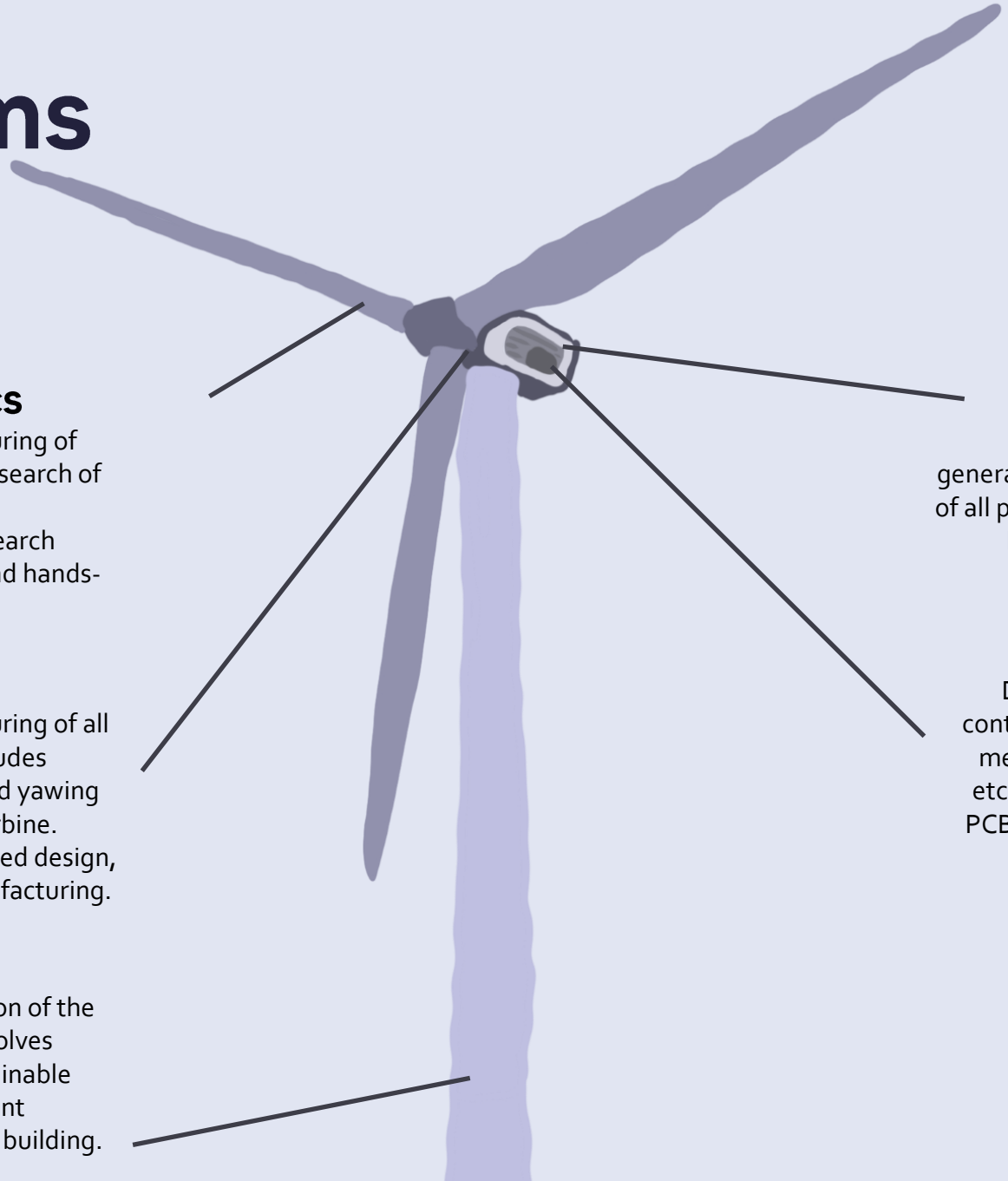


Height (m)	up to 15	up to 25	up to 50	up to 65	65 +
Rated Power (kW)	0-1.5	1.5-15	15-60	60-200	200-500
Applications	House	House or farm	Farm or business	Business	Business or community

Wind Turbines

- Commercial wind turbines (2-3 MW)
  - Onshore vs. Offshore
- Small wind turbines (0-500 kW)
  - Rural and rooftop applications

Sub-Teams



Aerodynamics

Design and manufacturing of the blades. Involves research of the newest materials, collaboration with research groups, simulations and hands-on composite work.

Mechanical

Design and manufacturing of all mechanical parts. Includes rotational, pitching and yawing mechanisms of the turbine. Involves computer-aided design, prototyping and manufacturing.

Structural

Design and construction of the tower and nacelle. Involves research of most sustainable materials, finite element analysis and hands-on building.

Power

All things to do with the generator! Design and assembly of all power electronics. Involves PCB design, soldering and testing.

Controls

Design and assembly of all control systems: performance measurement, pitch control, etc. Involves microcontroller, PCB, and programming work.

International Small Wind Turbine Contest (ISWTC)

International Small Wind Turbine Competition

- Annual contest in which university student teams from around the world compete in building a Small Wind Turbine
- First organized by NHL University of Applied Sciences in 2013
- Currently organized by the Hanze University of Applied Sciences
- Goal: To build the most efficient & sustainable wind turbine with the highest energy yield
- Lasts for 1 week in June/July

Hanzehogeschool Groningen
University of Applied Sciences

International Small Wind Turbine Competition

Deliverables:

- Design Report
  - Technical design choices
  - Research
  - Outline of turbine construction
- Sustainability Report
  - How feasible is the construction of the turbine in developing regions (ex. Sub-Saharan Africa)
  - Life cycle assessment
  - Embeddedness
  - Maintainability
  - Materials
- Turbine
  - Electronics/mechanical safety
  - Tested in Open Jet Tunnel at Technical University of Delft (best power production) (2-3 hrs)

International Small Wind Turbine Competition

Presentation:

- Present turbine & poster to other teams, general audience, and jury of wind energy experts

Weight Breakdown

- 60% Energy Output
- 20% Sustainability
- 20% Report & Presentation

Example Turbines

a. Wind tunnel

b. UofT

c. Lodz University of Technology

Progress

Timeline

F24: Recruitment, sponsorships/funding, and advisory professor.
Designs for each sub-team completed and manufacturing plans set.

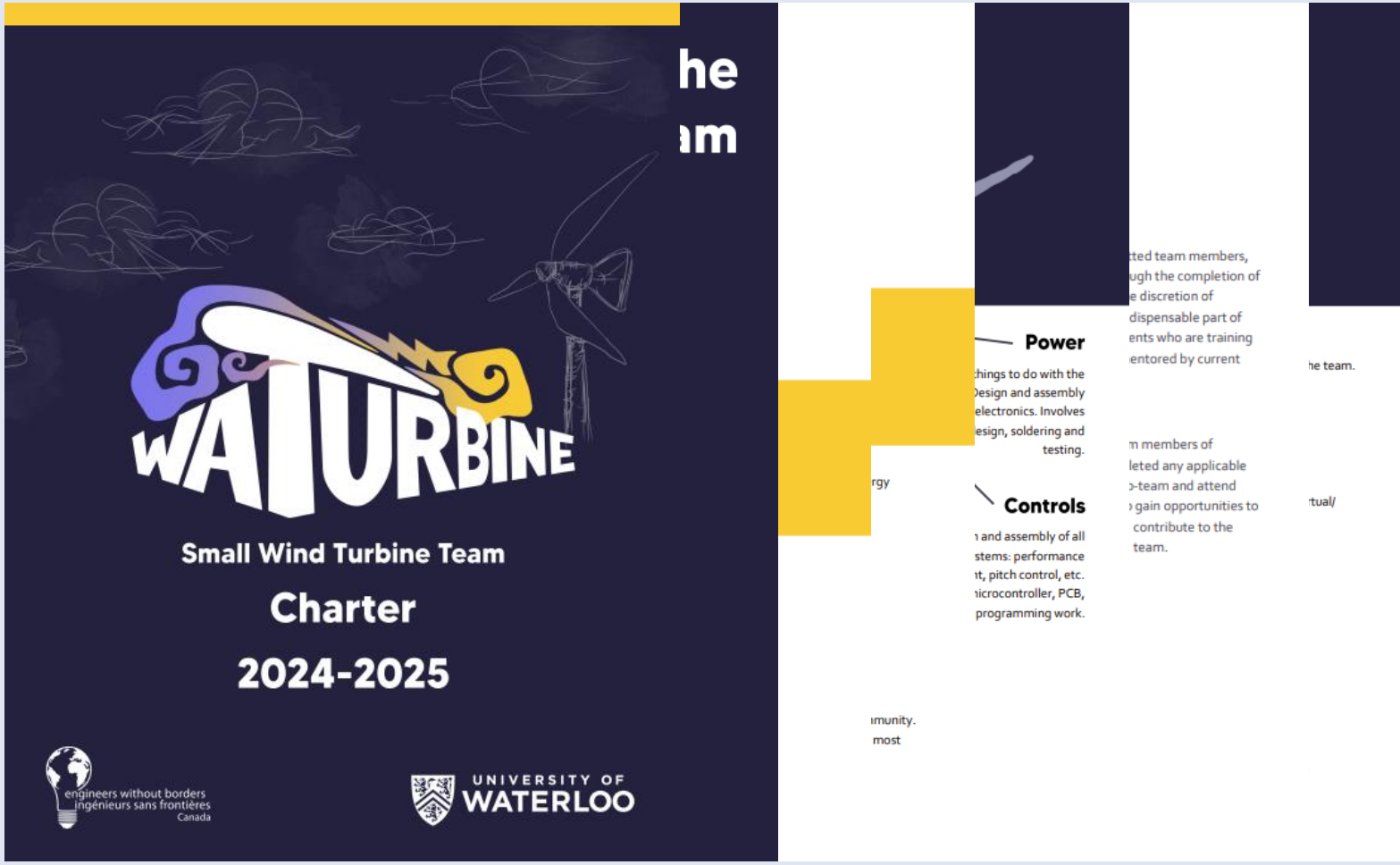
December 2024: Registration opens for the ISWTC. 500 euro fee paid.

W25: Manufacturing, construction, and testing of the turbine takes place in tandem with the research/writing for all reports and presentations.

S25: Competition occurs.

Team Charter

- Linked on our Notion!
- Mission
- Sub-teams and leadership
- Structure
- Tools
- Onboarding process



Sponsors

- Package completed
- Start reaching out this week-next

Aerodynamics

Aerodynamic Leads

Alan Hu
Aerodynamics Lead

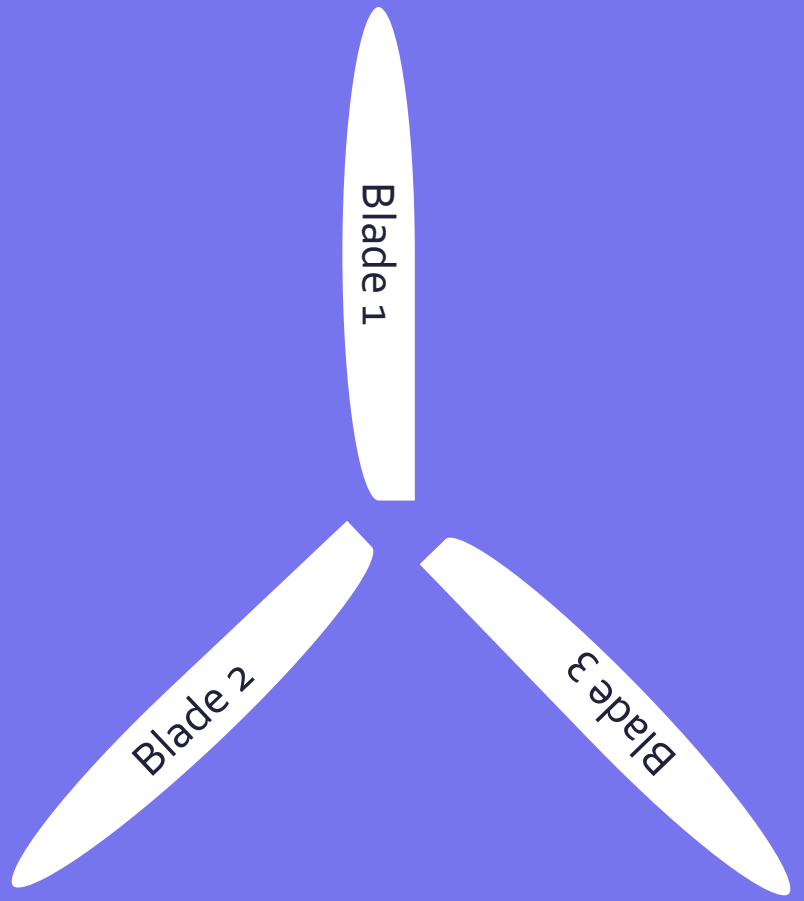
Blade 1

Violet Hu
Aerodynamics Lead

Blade 2

Katherine Liu
Aerodynamics Lead

Blade 3



Overview

- We are the blades!
- Join us to explore and learn all about the theories and functionality of airfoils and aerodynamics

- Weekly Meetings: **Wednesdays @8-9pm**
  - CPH 3678
  - Discord VC: Staer(e)o

Projects

F24

- Airfoil selection and blade design
  - QBlade
- Wind speed and pitch table for controls team (variable pitch)
- Finalize manufacturing plans and timeline
  - Research on manufacturing method for blades
  - Material selection for blades
  - Refine cost estimations

W25

- Blade manufacturing
- Testing and Integration with other subteams (mainly mechanical and controls)

Onboarding

- QBlade fundamentals
  - Blade design and wind turbine simulation
  - Read over documentation in our OneNote

Controls

Controls Leads

Steven Armstrong
Embedded Systems Director

Xander Hayhoe
Controls Lead

Overview

- Develop PID algorithm for optimizing Pitch
- Measure real-world precision of servo motors
- High level system design
- Work hand-in-hand with Power team

- First team meeting Sunday Oct. 6, 6:30pm

- Join this team to work with Teensy, STM32, C/C++, Python, and CAN

Projects

F24

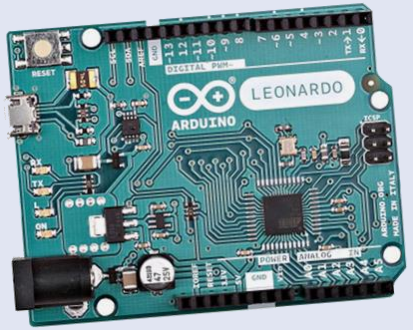
- Onboarding Challenges
- Part sourcing
- Microcontroller research
- Start work on initial PID Algorithm

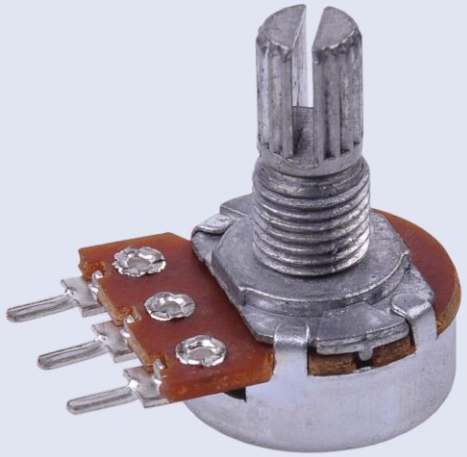
W25

- Part collection
- Build relevant circuits
  - Design and print PCBs if time allows
- Fine tune initial algorithm
- Work with Aero and Mech teams to assemble rotor

Onboarding

- Challenge: Control a servo using a potentiometer with spare Arduinos, breadboards, potentiometers, and servos.
- Tools needed: Arduino IDE for programming.
- Demo requirement: Show working code to proceed with team onboarding. Debug and retry allowed with feedback provided for troubleshooting.





Mechanical

Mechanical Leads

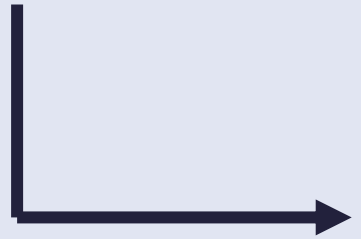
Evan Kwon
Mechanical Lead

Robert List
Mechanical Lead

Jun Woo Oh
Mechanical Lead

Overview

- Join us if you're interested in the design and/or manufacture of dynamic mechanical system!
  - Lots of opportunities for problem solving and design
  - Since many of the sub-systems have very open-ended solutions, you'll have lots of opportunities to shape the outcome of the design
- Weekly meeting times and locations TBD
  - 2/3 members offsite, one of which is in an inconvenient time zone
  - For the time being, discussions are on discord



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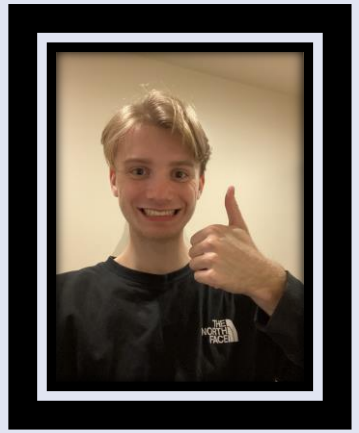


Projects

F24

- Sub-system definitions and requirements
  - Assigning constraints and design goals to each sub-system
  - Hand calcs to get a rough idea on sizing components
- Detailed CAD models for each sub-system
- Small scale prototyping

W25

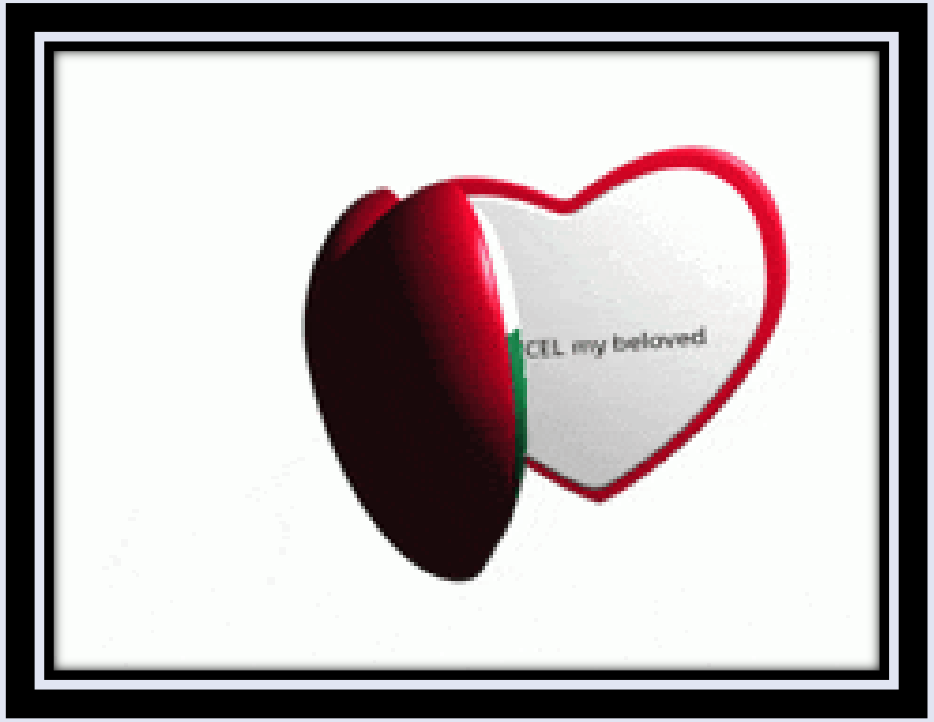
- Material sourcing and BOM management
- Manufacturing parts and assembling sub-systems
- Iterative design process when we inevitably run into issues ☺

Onboarding

- No onboarding task required ☺
- Read through (and adhere to) the CAD design handbook (WIP)

Not required, but is a plus if you have:

- Excel skills!
- Ability to sketch ideas on paper
- Mechanical system design experience (i.e. through a robotics team)



Power

Power Lead

Ben Liu
Power Lead

Overview

- Designing self-startup system
- Battery system will also allow for stable power output
- Exploring options to maximize power output
- Work hand-in-hand with Controls team

- First team meeting Sunday Oct. 6, 6:30pm

- Join this team to work with circuit design, power generation, battery management, etc.

Projects

F24

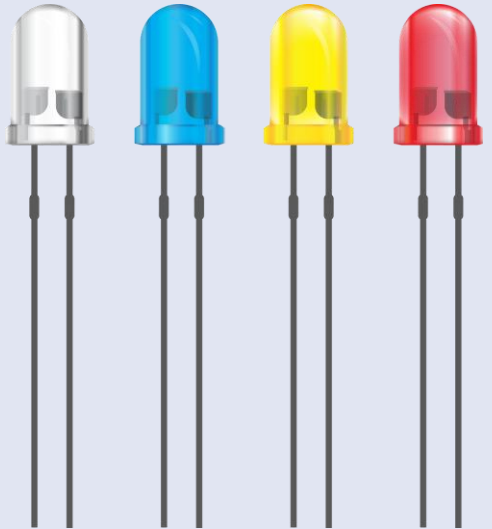
- Research necessary electrical fundamentals for parts selection
  - Coordinate with aero team for generator selection
  - Coordinate with controls for feedback systems
- Draft initial main circuit
  - Draft required sub circuits and PCBs
    - Including safety mechanisms
- Source parts and manufacturers (if needed)

W25

- Test all purchased electrical components
- Assemble power management boards and motor control systems
- Work with Structural team to mount generator
  - Make changes to structural team requirements as needed
- Assemble circuitry on turbine frame
  - Test circuitry and components after assembly

Onboarding

- Electrical Safety Training – Self-Registered LEARN Course
- Onboarding Task: Demonstrate basic electrical principles using a real DC Motor
  - Really just spinning a brushed DC motor by hand
- Expected outcome: The multimeter will display a reading and potentially light up an LED



Structural

Structural Leads

Chantel LeClercq
Structural Lead

Laasya Rajgopal
Structural Lead

Overview

- Research 
  - Research sustainable materials for tower
  - Explore the fabrication of the nacelle
- Design work 
  - Design the nacelle and portable (potentially foldable) tower
  - Conduct FEA and CFD on the designs
  - Learn how to integrate with other sub teams
- Manufacturing 
  - Hands-on manufacturing of nacelle and tower in Student Machine Shop

Projects

F24

- Finish Material Selection 🦵
- Establish Material Procurement Resources / Exact Costs 💰
- Establish Manufacturing and Procurement Timeline 🕰️
- Complete CAD Model of Tower and Nacelle 🖼️
- System Integration (CAD ☺)

W25

- Acquire Materials 🤝
- Make the Tower (try not to break it challenge!)
- Report Writing ✍️
- System Integration (not CAD ☹)

Onboarding

- Structural Design Considerations
- CAD (Models)
- Simulations (FEA and CFD)

📢 Meetings: Wed @6pm on discord! (be there or be squared)

Recap

1. Fill out the form
2. Join the Discord and look through #resources
3. Meetings
    - General WATurbine Meetings
        - Thursdays @ 9PM in E7 1401 and on Discord (Round Table VC)
    - Aerodynamics
        - Wednesdays @ 8PM in CPH 3678 and on Discord (Staer(e)o VC)
    - Controls & Power
        - Sundays @ 6:30PM, location TBC and on Discord (Remote Control + Powerade VCs)
    - Mechanical
        - Weekly Meeting TBC
    - Structural
        - Wednesdays @ 6PM on Discord (5'6" VC)