Engineering Design Challenge

Find your team number (on the wall).

If all 6 team members are present, pick up your team number sign, and sit together as a team.

All others please stay by your team number and wait for instructions.

Engineering Design Challenge

Welcome!

Please sit with your team for this presentation

Engineering Design Challenge

WIND IT UP!

A (not so) easy, breezy challenge

Developed in collaboration with Boeing Engineers

Presented by Tony Castilleja and Dayni Alba

Engineering Design Challenge from the 32nd Annual TAME State STEM Competition sponsored by Boeing and hosted by CPS Energy at La Villita Assembly Building in downtown San Antonio, Texas on April 8th, 2017.

Engineering Design Challenge

Why a Design Challenge?

- Learn the Engineering Design Process
- Work with a team of other talented TAME students
- Have fun!

Today's Challenge

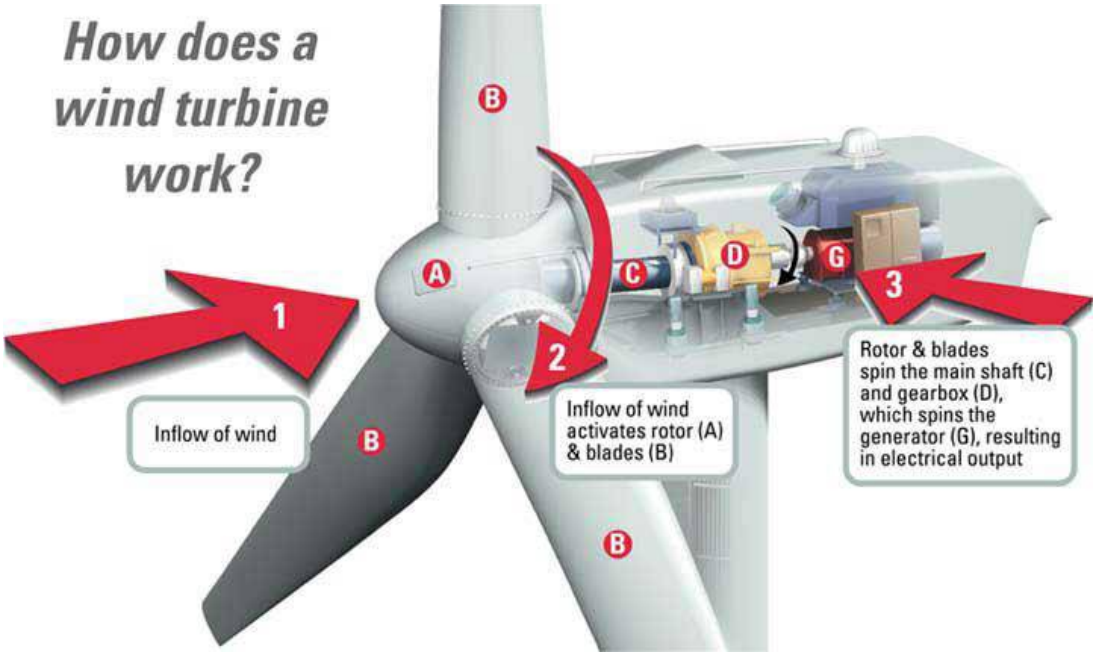
Design, test, build, and demonstrate the rotor for a wind turbine. All teams will have access to the same generator and structural support at the testing and judging station.

Wind Turbines

A wind turbine is a device that converts the wind's kinetic energy into electrical power. There are three components to a traditional wind turbine –

- The rotor, which includes the blades for converting wind energy to low speed rotational energy.
- The generator, which includes the electrical generator, the control electronics, and components for converting the low speed incoming rotation to high speed rotation suitable for generating electricity.
- The structural support which includes the tower and rotor yaw mechanism. The yaw mechanism ensures that the wind turbine rotor is always facing the wind.

Parts of a Turbine



Wind Turbines

During the 1980s, Boeing engineers built the largest wind turbines in history and constructed the first "wind farm".

Many of the ideas developed in those projects are used in developing wind turbines and wind farms across the world.

Aerodynamic modeling is used to determine the optimum tower height, control systems, number of blades and blade shape.

Wind Turbine Design

The Wing is the Thing

The Challenge

Your team will use the materials provided to design and build one or more blades that can be attached to the turbine hub.

The hub will be connected to the generator and the turbine will be powered by a fan placed near the unit.

When the blades turn in the wind, the turbine hub spins and the generator produces electricity. A multi-meter will be used to measure the electric current generated at different fan speeds. Three measurements will be taken at each speed, and teams will earn more points if their wind turbine produces a consistent level of electric current at each speed.

The Challenge

Information about a wind turbine built using similar materials is included in your packet.

Your challenge is to build a wind turbine that is more
cost efficient (uses fewer materials) and
conversion efficient (produces more electricity, measured in micro amps)

Your team must test the wind turbine at least once before time is called and record the electric current generated at this test.

You must then use this information to describe to the judges why your design is cheaper and better.

The Challenge

In any real-world project, cost is an important consideration. So teams are encouraged to carefully consider the materials they need and want to use in building this turbine.

Your team will be awarded points for unused materials returned at the end of the building phase.

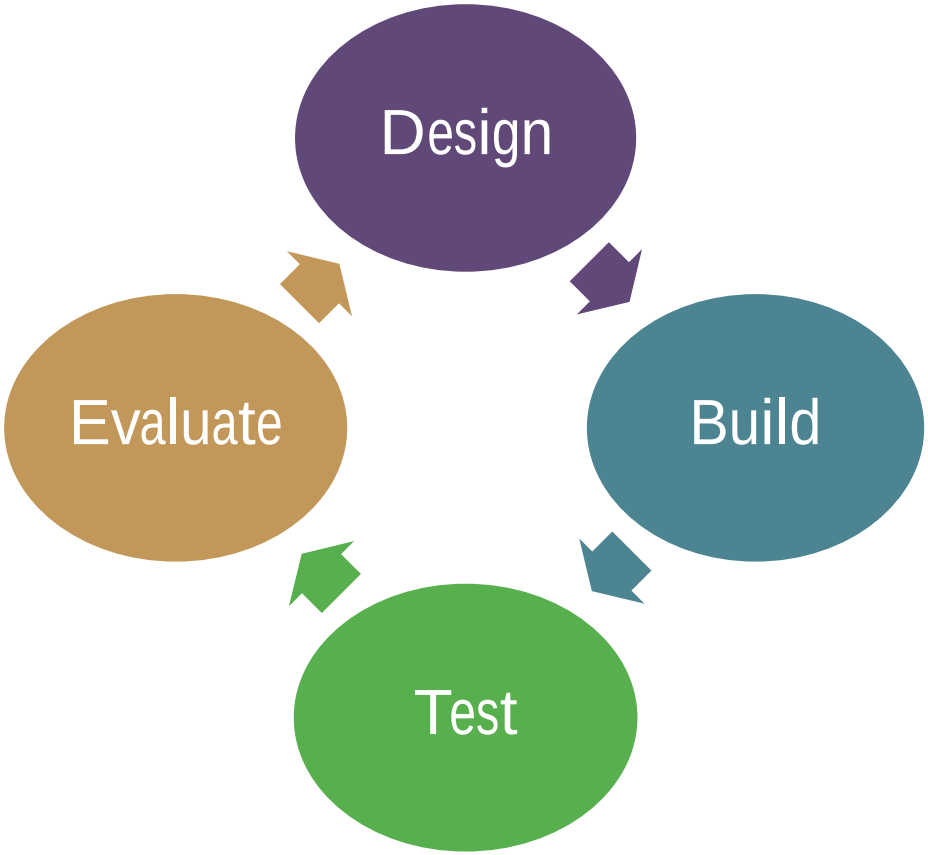
Challenge

You will have 60 minutes to design, build and test your project.

Suggested schedule:

- Design – 10 minutes
- Build – 30 minutes
- Test and refine – 20 minutes

Engineering Design Process



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Team Roles

Each team member has a role and each role is assigned to a team member

- Systems Engineer
- Design Engineer
- Structural Engineer
- Materials Engineer
- Sales Engineer
- Test Engineer

Teams and Supplies

Each team will be given the same set of instructions and supplies.

Be sure to check your supplies immediately since any missing supplies must be replaced in the first five minutes of the challenge.

Read all instructions carefully before beginning the challenge.

Design Requirements

- Teams must test their turbine at least once before time is called, and record the electric current generated by their turbine. Teams must compare their turbine's performance to the sample turbine performance and explain why their design is better.

- Teams must return all unused material when time is called. Teams will earn points for each unused item they return.

- The team-designed turbine blades must be attached to the hub provided. This hub must be mounted on the generator and start from rest.

- Blades must be shorter than the tower on which the wind turbine will be mounted. Blades must be shorter than 15 inches to meet this requirement.

Testing Protocol

- The Structural Engineer will connect the turbine hub to the generator
- The Test Engineer may get the blades rotating by gently spinning the turbine. If the blades fall off or the turbine breaks as a result of this spin, the teams will not be able to make any repairs and will not receive any scores for performance.
- The fan will be turned on at low speed at the start of testing, with the multi-meter connected to the wind turbine. The multi-meter reading (in micro amps) will be recorded 20 seconds after the fan is turned on. Two more multi-meter readings will be taken at this fan speed, and they will be spaced 20 seconds apart. The fan speed will be increased to medium and 3 measurements will be taken at this speed, in 20 second intervals. The fan speed will then be increased to high and 3 measurements will be taken at this speed, at 20 second intervals. The fan will be turned off only after all 9 measurements are recorded.
- Team members may not touch the wind turbine once testing begins

Scoring

Consistency (steady current generation) and
Economy (least amount of materials used)
will increase team scores

Total Score = Design score + (Presentation Score * Cost Factor) + Performance Score

Other recognitions: Creative use of materials, innovative design, teamwork

Recommendations

- Spend about 10 minutes planning and drawing your design before building.
- Test your rotor as you build to make sure it works. All teams are required to test at least once in the build phase.
- Divide and conquer – allow team members to work on different parts of the design.
- Be creative. There are many different ways to build an effective, efficient turbine. So think about different approaches you could take.

Engineering Design Challenge

Read the instructions carefully, follow them precisely.

Read what the rules state and base your decisions on the rules.

If the rules do not state that you cannot do something, then you may do it, as long as it is safe and not destructive.

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Engineering Design Challenge

You are responsible for cleaning up your work area. You will not be judged until your area is clean and all trash has been thrown out.

Engineering Design Challenge

Wait until your team number is called to leave this area.

Good luck!